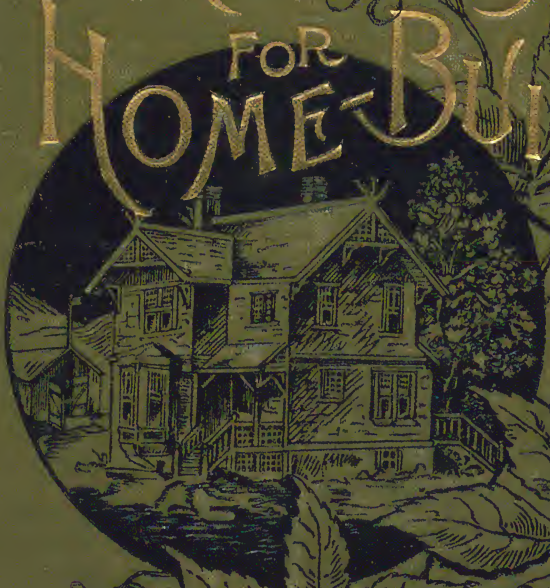
HOMES FOR HOME-BUILDERS



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HOMES

FOR

HOME-BUILDERS;

OR

PRACTICAL DESIGNS

FOR

COUNTRY, FARM AND VILLAGE.

EDITED BY
DAVID W. KING, ARCHITECT.

WITH NEARLY TWO-HUNDRED ILLUSTRATIONS.

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PREFACE.

I herewith present designs by eminent architects and others, executed for the publishers of this volume, classified and properly arranged, in order to meet the wants of those who reside in the country and are unable, without difficulty, to secure the services of skilled architects. It has been my aim in overseeing this work, to present a variety of designs which, with few additions and changes, can be adapted to the requirements of individual tastes of those about to build, whether living in village or country.

For more important building designs, complete specifications, bills, quantities, and estimates of cost are given. The estimates have, in nearly every instance, been practically tested; but, owing to the variation in the prices of materials and labor in different localities, they can only be assumed as approximately correct. To obviate this difficulty, the Memoranda for Estimating, found in the back part of this work, have been prepared.

For the various data employed in the Introduction, and notes on Cements, Mortars, and Estimating, I have consulted the following authorities: E. Turner, W. P. Gerhard, Edward S. Philbrick, F. E. Kidder, Geo. W. Powell, L. E. Brown, T. M. Clark, Prof. Charles Babcock of Cornell University, and Trautwine's Hand-Book.

This volume is not a treatise on art or architecture, but is simply offered as a plain and practical aid to people who desire to build at moderate cost.

DAVID W. KING.

November 1, 1885.

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HOMES FOR HOME-BUILDERS.

HINTS ON BUILDING.

In building a new house, there are many important things to be separately considered, viz: the position of the house in relation to the points of the compass; the character of the soil; the water supply; the drainage and sewerage; the plumbing, warming, and ventilation. The arrangement of rooms, halls, and closets, the location of stairs, doors, windows, chimneys, and verandas; the materials, construction, painting and decorating.

SITE.

The situation and aspect of a house, are the most important features; and it should be borne in mind, that sunshine is as essential to life and health as fresh air. To every room in the house, according to the service to which it is appointed, there is a choice of location. The principal factor to be considered, is the number of hours of sunshine. On the longest day, the sun rises east north-east, and sets west north-west. When the days and nights are equal in duration, the sun rises in the east, and sets in the west. On the shortest day in the year, the sun rises east south-east, and sets west south-west. When the house stands fronting either of the cardinal

points, the north front gets a few hours' sunshine in the morning and evening, in the hight of summer only. The east front receives the morning sunshine until half-past ten o'clock. The south front from seven A. M., until five o'clock, P. M., all the year around. In mid-winter, all the time the sun is above the horizon. The west front from half-past one o'clock until sunset. When the house stands with the angles to the points of the compass, the south-east front has the benefit of the sun from its rising, until one o'clock, P. M. The north-west front from half-past four o'clock until sunset. The south-west front from half-past ten o'clock, A. M., until half-past seven o'clock, P. M.

Naturally, a northerly aspect is always bleak and cold, and almost always damp. An easterly aspect is cold, owing to easterly winds, which prevail at some seasons of the year, but is fairly dry. A southerly aspect combines all the dryness and sunshine the climate affords. A westerly aspect is warm in summer, but is exposed to cold winds in winter, and boisterous storms at all seasons. A southern exposure, sunny in front and open at the back, is the best. While it is not always possible to have a south front, the principal living rooms may almost always be arranged so that they shall receive a good share of sunlight. The dining-room should be upon the east or south-east side of the house, with an outlook upon something pretty. The sitting or living room should be bright, warm, and cheerful, with broad, generous windows, admitting plenty of light and sunshine, and should, therefore, have an outlook either south-east, south, or south-west. The library should be isolated as much as possible, and should never communicate directly with a room where music is carried on, and should not be in a position to be made a public thoroughfare. The drawing-room, or parlor, may be located as may be most convenient. The kitchen and store-room should be placed at

the back of the house, and to the north where possible, with plenty of light and air. The bath-room should have a southern exposure. Bedrooms should be located where they will be light and airy. Then as to the surroundings. High hills near by, ponds, lakes, railroads, canals, sluggish streams, stagnant pools, swamps, marshy or low lands, sewerage or drainage from slaughter-houses, and cemeteries, are bad neighbors always.

SOIL.

The soil on which the house is to be erected, should be free from impurities to start with, and should be kept constantly unpolluted. In order to keep the air of the home pure and healthy, there must be no damp foundations or walls, no dark corners to confine the air and devitalize it, and no filth in or around the dwelling to pollute it. It requires continual vigilance and cleanliness everywhere. To live on a poisonous soil, is to breathe poisonous air. Naturally, clean soils are often made impure by drains and cess-pools.

No dwelling-house should be built without a solid substratum of concrete under the whole of it. A damp soil has a tendency to promote rheumatism, catarrh, neuralgia, phthisis, intermittent and enteric fevers, cholera, and dysentery. Hence, a damp soil should be avoided, and if it cannot be avoided, the site must be effectually drained. Undrained clays, stiff marls, and soils of fresh water origin are generally bad. Made ground is always suspicious, and should never be built upon, if it can possibly be avoided, and in no case less than four years after its formation, and after having been thoroughly drained.

Sandy soils are healthy, when deep and free from organic matter; but when full of vegetable sediment are bad. Limestones, and Magnesian limestone soils are healthy, if free from marsh. The most healthy sites are

upon deep, high-lying gravels, or upon granitic metamorphic, trap, or sandstone formations, or above stiff, well-drained clays.

WATER SUPPLY.

A bountiful supply of pure, clean water, for drinking and cooking purposes, for bathing, for cleaning utensils, and flushing plumbing fixtures, is a most important feature in the sanitary arrangement of a dwelling. The quantity required depends upon the construction of the building, and the character of its occupants. Thirteen gallons may be assumed as the minimum quantity necessary for each person daily, where there are no water-closets or full baths. With daily use of water-closets, and a full bath for each person once a week, the supply of water should not be less than thirty gallons a day. The data on which the minimum of thirty gallons is fixed, are :

Domestic supply, without bath or closets	13 gallons.
General baths	6 "
Water Closets	8 "
Unavoidable Waste	3 "
Total	30 "

With the supposition that the water supply is constant.

The daily average number of gallons of water consumed in the following cities, per person, are :

Columbus, Ohio	30 gallons.
Cleveland, Ohio	40 "
Brooklyn, N. Y.	50 "
Philadelphia, Pa.	55 "
Boston, Mass.	60 "
Chicago, Ills.	75 "
Albany, N. Y.	80 "
New York City	100 "
Washington, D. C.	158 "

TANKS.

In country houses, the plumbing fixtures are usually supplied by pumping water from wells and cisterns into tanks, which are placed in the attic. And it is quite

important to know the proper dimensions of a tank, that shall hold the required quantity of water. Every cubic foot of room in a tank is equal to a volume of seven and one-half gallons, hence the daily supply for one person will fill four cubic feet of space. A cubic foot of water weighs sixty-two and one-half pounds, therefore, the entire weight of the water supply for one person is two hundred and fifty pounds. From this data, we can compute the weight of the entire tank, which, in a large household, or institution, would be many tons. Care should be taken, that the supports of house-tanks are sufficiently strong, otherwise it may cause settling in the building, and cracks in the plaster. Tanks intended to hold drinking water, should not be lined with lead or zinc, but with tinned or planished copper, or with slabs of slate, joined with cement. Every tank should be carefully covered, and provided with a proper overflow and vent-pipe, and should have a lead "safe," underneath, to guard against leakage. The overflow pipe from tanks or cisterns, should have no connection with the soil or drain pipes, but should discharge over an open sink in the kitchen, or some other convenient place.

CISTERNS.

In many localities, rain water collected in cisterns is the only supply, and it is necessary to know the quantity of water, that will be received from a roof at a given time. As the annual rain-fall varies greatly in different localities, only an approximate computation can be made. Trautwine says, that there are few localities in the United States, where the rain-fall is less than twenty-four inches; allowing one-half for evaporation and waste, we would have twelve inches rain-fall received in the cistern. One inch of rain-fall is equivalent to 4.673 gallons per square yard, or approximately, one-half gallon per square foot. To calculate the quantity of

water a roof will receive, multiply the length by the breadth, adding the projection of the eaves and barge-boards, which will give the number of square feet in the horizontal area of the roof. Multiply this result by the number of estimated inches of rain-fall in that locality, allowing one-half for evaporation and waste, will give approximately the number of gallons received annually from the whole area of the roof.

Underground cisterns are usually built of brick, and plastered inside with good cement. No cistern should ever be in direct communication with any water-closet or sewer, and the overflow pipe should be protected by a copper or galvanized iron wire netting, to prevent the ingress of reptiles and vermin. The top should be domed, and provided with a tight-fitting cover. The cistern should be located where it will be accessible for cleaning, which operation should be performed at least four times a year. Water pumped from cisterns, and from most wells, should be filtered through finely powdered charcoal, or carded asbestos, before being used for drinking or cooking purposes. These filtering substances must be renewed, or cleaned from time to time. The charcoal may be cleaned, by heating in a pan over a fire until very hot, and asbestos is purified by holding it in an open flame.

WELLS.

A well should never be sunk within two hundred feet of a cess-pool, for if supplied by so-called "sub-surface" water, and not by deep-seated living streams, they drain a vastly wider area than their depth indicates. The deeper the well, the larger the area drained. If sunk through an impervious stratum, or on a hill-side, or where some dip in the sub-strata occurs, the well may draw its supplies from several localities, many feet apart. It is a common thing to see a well in such a position, that it

catches sub-surface water, and barn-yard and privy drainage, and that from kitchen and laundry sinks. Drinking water, which such sources have made impure, becomes the origin of such diseases as typhoid and malarial fevers, diphtheria, scarlet fever, etc. The clearest and most sparkling water is sometimes the most poisonous. Open wells should be protected by a curb, and the surface should be graded so, that all surface water may be carried away.

In driven wells, there is less danger from surface drainage, but the water in any well should always be tested carefully before it is used for drinking or cooking purposes, which can usually be done, by taking a sample to a competent chemist or physician near by.

DRAINAGE AND SEWERAGE.

In draining a building, the object is to dispose of the water and refuse from the different appliances quickly, and in such a manner, that no poisonous gases will be admitted into the house. The drain pipe must be of good quality, and laid as straight as possible, with no right-angled junctions. Where bends are unavoidable, bent pipes should be used. The pipes should be laid on a solid foundation, to a regular fall of not less than four inches in ten feet, and the joints put together in cement, and care must be taken, that the cement is not squeezed up between the joints, so as to form a ridge, like a dam, on the inside, and the drain should be thoroughly inspected and tested, to be certain that there are no leaks. The salt-glazed earthen pipes, manufactured at Akron, Ohio, are the best in the market. All drain and soil pipes inside the house, should be of cast-iron, and the joints caulked with picked oakum, and molten lead, all well painted, and the waste-pipes from all plumbing fixtures should be carefully trapped and ventilated.

Small sewers are better than large ones, as they are

more liable to run full, and thus be kept better scoured. A four-inch sewer is quite large enough for any dwelling, or small institution. Drain-pipes should never be laid in the same trench with the water supply-pipes. The quantity of sewerage discharged every day varies with the amount of water used. In cities it may be estimated from thirty gallons per day, and upwards. Every line of soil-pipe should stand as nearly vertical as possible, and should be carried up full size, which is usually four inches in diameter, to a point near the roof; from this point, the diameter should be increased to six inches through the roof, and at least three feet above it. It should not be located near a chimney, window, or an open rain conductor, that leads to the cistern, and should be at least two feet lower than the chimney tops, so that down draughts may not take the foul air into the house. There should be no return hood or cowl, as these check the air currents. A copper wire ball screen is the best guard for the top of a soil-pipe, or leader. There should always be an inlet for fresh air near the foot of every line of soil-pipe, between the pipe and the trap of the iron house-drains. In country places, this inlet pipe may be arranged so, that its mouth may be behind a tree or shrubbery; it should have the same diameter as the soil-pipe, and the air inlet must not be near doors or windows, or the fresh air supply of the furnace. The fresh-air opening should also be protected by a wire screen. Vent pipes from water-closet seats should never open directly into a chimney flue, as there is danger of downward draughts, when the fires go out.

Privy vaults are always dangerous and offensive, and should never be used. Outside privies should be set upon piers or posts, and strong boxes coated on the inside with hot coal tar, should be used to receive the compost, which must be kept as dry as possible, and removed often. The employment of dry, sifted earth, or road

dust, applied upon the contents of the box, either after each use, or at least once a day, is to be recommended, as it represses all disagreeable odors. Every privy should be thoroughly ventilated by an air-shaft, extending from the seat of the privy to a hight of from six to ten feet above the roof; the sectional area of this ventilating shaft should be equal to the area of the holes in the seat. If constructed in this manner, the privy will be free from the offensive stench, so common in such out-houses. Good authorities agree that sub-surface irrigation is the best method for carrying off the liquid waste from kitchen and laundry slops in country dwellings, where there is no proper sewerage. The system requires the use of a flush tank, which may be discharged by hand, or by an automatic flush-tank, with an automatic discharge, strainer, and grease-trap. This tank stores up the fluids for several hours, and then sends them suddenly and copiously throughout the lines of open-jointed small drains, laid ten or twelve inches below the surface of the ground. These should be from fifty to sixty feet in length for each person, and laid in ordinary soil. The polluted liquids reaches the ground at a great many points, and is oxidized by the air in the top soil, and the roots of vegetation take up the injurious matter. The amount of sewerage, which may be disposed of in this way, is unlimited, provided the lines of pipe are long enough, and spread over sufficient area to take up the water. A grassy field is required, not land under tillage.

Utensils for night use, bed-pans, and commodes for persons who are ill of diarrhea, typhoid fevers, etc., should always have tight-fitting covers, and should be washed daily in hot water and soda, and disinfectants should be used to cover the discharges, and to rinse the vessels afterwards. Oil and turpentine, rubbed on the wood-work, will take away bad odors from a room. Refrigerators and meat-rooms should never have any connection

with soil or sewer-pipes, and their waste-pipes should discharge into the open air, or into a pan exposed to the air ; this pan or sink may be connected with some waste-pipe, properly trapped.

HEATING AND VENTILATION.

For heating and ventilating farm and country houses, a combination of an open fire-place, and a hot-air furnace, is the most satisfactory and inexpensive. All rooms that are heated by currents of hot air, give a higher degree of temperature near the ceiling, and this is partly corrected by the open fire-place.

In order to get good results from a hot-air furnace, the joints should be tight, the exits for smoke and gas, the evaporating pans, the fresh air boxes, and air chamber, should be of ample size, as a large body of air moderately heated, is better than a small quantity heated to a high degree, as the currents of moderately heated air, become thoroughly mixed with the air of the room, while a current of very hot air, is liable to pass directly through. There should be two cold-air boxes, leading from opposite sides of the house, so that, when the wind blows violently, there may be an exit for the extra quantity of air, which would otherwise be forced into the room too rapidly, to become sufficiently heated. The sectional area of the cold air ducts, should be equal to the sum of the sectional area of all the hot-air pipes, leading from the furnace, and the mouth of the cold-air ducts should be guarded by a fine wire netting. Where there is much dust, a piece of clean cloth or flannel, stretched over the mouth of the cold-air ducts, will act as a filter, and purify the air to a great extent ; this filter should be changed frequently. The mouth of the fresh-air ducts should not be placed near a sewer, or cess-pool, and no rubbish or filth should be allowed to accumulate in this vicinity. There should be no damper in the fresh-air boxes, as

they are liable to be closed by some careless person, and forgotten. If it is desired to check the draught, to reduce the heat of the fire, the capacity of the smoke-pipe should never be reduced, but the openings below the fire may be closed, and exclude the air from the grate. The air-pipes, where attached to the furnace, should all be kept the same hight, otherwise the more elevated pipes will receive more than their due share of heat, and where possible, they should not extend horizontally from the furnace above a distance of ten or twelve feet. Hot-air registers should be placed in the walls where practicable, and not in the floor, as dirt and dust will collect in them, and careless tobacco chewers have been known to use them as a cuspidore. They should always be made so that they may be removed when desired, for the purpose of cleaning. Finally, cleanliness and care are necessary to keep a furnace in proper working order.

PLUMBING.

Cheap fixtures, as well as poor workmanship, in plumbing, is not economy, as the pipes, faucets, basins, etc., soon get out of working order, and require constant attention and repairing.

The best kitchen sinks are those made of earthenware, or porcelain—the cheapest of cast or galvanized iron; enameled and painted sinks are of little account, as the coating soon scales off. The outlets of all kitchen sinks should be through a protected strainer, to prevent obstructions entering the waste-pipe. This should not exceed one and one-half inches in diameter, and should always be trapped as close to the sink as possible, and have a vent-pipe connected with the crown of the trap. The size of the sink will depend upon the number of the inmates of the house, and the quantity of work to be done. A sink, fifteen inches wide, and twenty-seven inches long, by six inches deep, is a fair size for a com-

mon country house. For a farm-house, where there are many milk-pans to be washed, etc., the sink should be proportionally larger.

Stationary wash-bowls should be of porcelain, set in a counter-sunk marble slab, and have a marble back at least ten inches high. They should be arranged, so that their contents may be emptied quickly. When the pressure of water is not great, a waste-pipe, one and one-half inches in diameter, is quite sufficient. Stationary wash-bowls should be placed in a separate dressing-room, or bath-room, and never in a bedroom.

Bath-Tubs.—Porcelain and ceramic bath-tubs are undoubtedly the best, but are too expensive to be used in a moderate priced dwelling. A "fourteen-ounce" planished copper bath-tub is quite good enough for an ordinary dwelling, but for the best work the heavier brands should be used. There are five grades, designated as follows: twelve ounces, fourteen ounces, sixteen ounces, eighteen ounces, and twenty ounces. The walls of a bath-room should be painted, but never papered. The floors should be made tight, and a "safe" should be placed under the bath-tub, to guard against leakage upon the ceilings below. The waste-pipe from the tub should be from one and one-half to two inches in diameter, securely trapped and ventilated. A wainscoting of white enameled tiles give an appearance of neatness to a bath-room, at comparatively small expense.

WATER CLOSETS.

Some form of a wash-out closet in which the basin forms a trap against gases, is the best. Such as the "*Inodora*" closet, manufactured by J. L. Mott, 88 Beekman St., New York. Closets, where the flow of water is produced by pressure on the seat, are almost always filthy. The pan closet, and valve closets have also been condemned by good authorities. Water supply for flush-

ing a closet should not be drawn directly from the main house supply, but should have a separate water-tank, otherwise there is danger that this water may become polluted.

CONSTRUCTION.

A dwelling should be constructed so that it will be dry at all times; cool in summer, and warm in winter. To fulfill these requirements, there are many things that should receive careful attention. When the house stands on damp soil, a drain should be dug outside the foundation walls, below the level of the cellar bottom, in which porous drain tiles, or vitrified pipe, pierced with holes, should be laid with a fall towards the lowest point of ground, and fill in with clean gravel or coarse sand as high as the top of the tile; cover this with clay or compact earth, and ram the same tightly against the walls, sloping off the ground, so that all surface water will be carried off.

Foundation walls should be faced and laid to a line on both sides, instead of being faced on the inside only, as is generally done. The frame should be erected plumb, and all the joints brought to a level on the top; all door and window openings should be trussed to prevent settlement.

Window frames should be constructed carefully of dry stuff; the sills, should, in all cases, be rabbeted, the heads made square and true, and the sashes, fastening strips, and stops well fitted. White pine is the best material for window sash. There is a patent adjustable inside window stop so arranged, that it may be easily adjusted and tightened whenever the sashes get loose, or rattle. The weights should balance the sash. The hight of the window stool above the floor should not exceed two and one-half feet on the inside.

The following rules have been given to regulate the

size of windows as regards appearance, and the health and comfort of inmates. "The area of light should equal the square root of the cubic contents of the room." Another writer says: "There should be one square foot of window space to every one hundred cubic feet of contents of the room," which is about the same thing. Inside shutters should never be used without being boxed. Outside shutters are objectionable on account of appearance, but afford protection to the house.

Windows should never be very wide, because the shutters or blinds become heavy and inconvenient, and very soon get out of order. Outside shutters should have secure fastenings to hold them open and shut, otherwise they will soon be destroyed by the force of the wind.

DOORS.

Outside doors for dwelling houses should not be less than one and three-fourths inches in thickness, in order to be firm and durable. The width of an outside door should never be less than two feet ten inches, and the hight not less than six feet eight inches. Large doors should be avoided, as they lessen the apparent size of the building. When folding doors are used, there must be sufficient space for one person to enter, when only one door is open. This requires not less than two feet in the clear. Hence, folding doors should never be less than four feet and two inches in width; the hight may be from eight to nine feet.

The proportions of inside doors depend in some degree on the size of the apartment, and should not be less than two feet eight inches in width, nor less than six feet six inches in hight, for living rooms and chambers. Closet doors may be less in width, but should usually be the same hight as the doors of the rooms. No single door in dwelling houses should exceed three feet six inches in width. Bedroom doors should be hung in such a manner

that they will shield the apartment from view when partly open, and in case of illness protect the occupant from direct drafts. The doors of bath-rooms and water-closets should also be hung to shield the interior from view as far as possible. Wardrobe closet doors should swing so that they will permit the light from the windows to enter.

STAIRS.

Stairs and staircases are made of various forms, but the most essential characteristics are, convenience, strength, and safety. The place of the staircase should be convenient, the ascent easy and regular, and *winding steps* should be avoided, if possible. There should be landings at convenient distances; good architects say, "Never put above nine steps to one flight." The rail should be of sufficient size and hight for safety. The tops of newel posts should be rounded, and left without any sharp angles or corners. To prevent stairs from becoming rickety, they should be supported by strong carriages.

The following table will give the proper proportions of treads and risers.

Breadth of tread,	7	inches,	hight of	riser,	8	inches.			
"	"	8	"	"	"	7½	to 8	inches.	
"	"	9	"	"	"	7	" 7½	"	
"	"	10	"	"	"	6½	" 7½	"	
"	"	11	"	"	"	6	" 7	"	
"	"	12	"	"	"	5½	" 6	"	
"	"	13	"	"	"	5	" 5½	"	
"	"	14	"	"	"	4½	" 5	"	
"	"	15	"	"	"	4	" 4½	"	

Outside steps should not be less than twelve inches in width. The best materials for newels, balusters, and hand-rails, are mahogany, cherry, black walnut, and ash. They should be thoroughly kiln-dried, worked smooth, filed, and rubbed smooth.

PAINTING.

In the very best buildings, the wood-work receives four or five coats of paint, but in ordinary country houses,

three coats are considered quite sufficient. The paint in common use for painting woodwork, is chiefly composed of white lead, linseed oil, and turpentine, with some "drier." The white lead gives a body to the paint, and forms a soapy compound, by combining with the oil. The driers quicken the hardening. The linseed oil soaks into and fills up the pores of the wood. The turpentine is merely used to save oil, and to make the paint sufficiently thin to work easily. It evaporates quickly, and affords no protection to the wood. Red lead is much used with the priming coats, and for the first coat in painting iron work; it sets hard and dries well. The proportion of ingredients in mixed paints, depends upon the quality of the materials, the kind of surface, and the degree of exposure. A colored lead paint is made by adding pigments to white lead base. When red lead is used, the mixture does not require so much of the drier.

The proportions of the ingredients for the different coats are approximately, as follows: First, or priming coat, one gallon of oil to five pounds of white lead, and drier as may be required. Two-coat work requires one gallon of oil to ten pounds of lead. Three-coat work, the same quantity as for two-coat work.

After the priming coat is put on, all holes and cracks should be stopped with putty.

In painting outside work exposed to the sun, sufficient turpentine should be added to prevent blistering, and in cold weather to make it work freely. All knots should be shellacked before the first coat is put on. When colored paints are used, each succeeding color should approach more nearly the final color. The pigments which are ground in oil are the best. White lead must be kept in close vessels, or the action of the air will give it a brown shade. When exposed to the fumes of sulphur, it becomes darkened. White lead should not be used for painting iron work, on account of a galvanic action which is sup-

posed to occur and destroys the paint. The best paints for iron work are those in which the oxides of iron form the basis. The sesqui-oxide, or red oxide, is commonly employed. Zinc white is used for inside work, but is unsuitable for outside work, as the carbonic acid in rain water dissolves the oxide, and the paint soon peels off and disappears. Plaster which is to be painted, should be smooth and free from bubbles or blisters, and should be perfectly dry. Plastered walls should be washed down with a distemper, and left for some months before painting. Each coat, both on plaster and wood-work, should be sand-papered smooth, and all holes stopped before the next coat is put on.

For outside work, drabs, grays, brown and reds, are the most durable colors. Burnt umber and yellow ochre, mixed with white lead as a basis, makes a drab of warm tint for outside work. Yellow ochre and Venetian red, a good buff. Indian red and indigo makes a warmer shade of gray than lamp black, which is usually used alone, with the lead for a gray. Burnt sienna and indigo, or lake; Prussian blue and yellow ochre, make a pleasing shade of brown. Green may be formed by mixing Prussian blue and burnt sienna, or Prussian blue and raw umber, or with indigo and burnt sienna. Any of the above pigments which do not contain lead, may be used with zinc-white as a basis, and may be used for inside work.

When shingles are used on the sides of the building, a pretty effect may often be obtained by staining them with an oil stain consisting of a thin mixture of some pigment, such as burnt sienna, linseed oil, and turpentine. In general, it is not well to use too many colors in painting, as it is more expensive and has a tendency to give a house a cheap appearance. If the side walls of the second story are shingled, a good effect may be produced by painting the clapboarding and trimmings all one shade,

with the outside shutters one shade darker. The colors of the second story and roof, of course, should be in shades that will harmonize. It is impossible to give written directions for the proper colors to be used, as so much judgment, taste, and skill is required in mixing the ingredients and applying them.

VARNISHES.

Varnishes made from amber, gum animé and copal, are the most durable, and are adapted to work which is exposed to the weather or that requires frequent cleaning, such as coaches, etc., and for the best joinery and fittings of houses. Turpentine varnishes are made from soft gums, dissolved in turpentine, They dry quickly, and are lighter than oil varnishes, but are not so durable. Lacquers are made with softer gum, dissolved in alcohol. They dry more quickly, and become harder and more brilliant than turpentine varnishes, but should only be used for cabinet or inside work.

PAPER-HANGING.

Walls that are to be papered, should be thoroughly dry before the paper is hung. Any defects in the surface of the walls should be remedied, and the whole sand-papered and rubbed smooth with pumice stone. Then give a coat of size, which prevents the plaster from absorbing the paste. In re-papering old walls, the old paper should be removed, and the walls thoroughly scraped and cleaned, to prevent any possibility of injury from the decomposition of the old parts.

DECORATION AND FURNITURE.

The drawing room, or parlor, is one of the chief apartments of the house, and is devoted to the reception of formal visits, and to receive company; it is the place where the company assemble before and after dinner.

They should therefore be well furnished with such articles as will display the taste of the occupants, and serve to interest guests. The tables, chairs, etc., should be dispersed so as to occupy the central part of the room, and when well proportioned, they increase the apparent size of the same. The couches and sofas should be made to correspond with the chairs in general style, but not necessarily in pattern. The expression of the drawing room should be bright and gay, and the predominating colors should be light and delicate, with, perhaps, considerable gilt on the walls or wood-work. In the dining room, all should be consistent with the object of the apartment; a few small paintings or etchings may adorn the walls, but the chief furniture should be the side-board, dining table, chairs, and side tables. The side-board should be the richest piece of furniture in the room. Dining tables are of various kinds, but some form of the extension table, which can be adjusted to suit the size of the company, is best. The hight of a dining table should be twenty-eight inches, and in width varies from three and one-half to four and one-half feet. Good Spanish, mahogany, or quartered white oak, well polished, make the best tables.

THE LIBRARY.

The expression of the *tout ensemble* of a library should be sober and rich, and, therefore, requires less ornament than the drawing room; the difference should not be too strongly marked between them, but should chiefly consist in the cheerful brightness and gaiety of one, and the quiet richness of the other.

These effects may easily be attained by giving proper attention to the predominating colors of the room, and a relief of the gay one, by judicious contrast. The most important feature to be considered, is the construction and arrangement of the book cases, which, to be conven-

ient, should not be too high. Low cases, with a wall space above, for hanging pictures, is a good arrangement, when there is sufficient room for the books without building the cases high. The distribution of the shelves should be according to the sizes of books, and the racks or holes for the pins which support the shelves, should be adjusted so as to alter to any of the usual sizes. The sizes of books are as follows: Large folio, small folio; large quarto, small quarto; large octavo, small octavo, and twelve-mo.; and the extremes are:

Large folio, 19 inches high, and 13 inches wide.
Small folio, 15 inches high, and 11½ inches wide.
Large quarto, 13 inches high, and 10 inches wide.
Small quarto, 10½ inches high, and 8 inches wide.
Large octavo, 18 inches high, and 6½ inches wide.
Small octavo, 9 inches high, and 5½ inches wide.
Twelve-mo., 7½ inches high, and 4½ inches wide.

The lower range should always be deep enough for the largest folios, and the others may be distributed as may seem most convenient; but many people prefer to have the largest quartos in the upper range.

The central part of the library should be furnished with tables, chairs, reading desks, sofas, couches, etc.

Where the book cases are high, steps are sometimes required, but should be avoided, as there is always trouble and often danger in using them. When a library is intended to be used as a drawing room, the furniture and decoration should partake of the features of the drawing room, that is, should be lighter in effect. The arrangement and choice of ornaments must depend upon individual taste.

SLEEPING ROOMS.

Their characteristic features should be convenience, neatness, and comfort. The form and construction of the furniture should be simple, in order that they may be easily cleaned and, as a consequence, less liable to

neglect. The furniture of bedrooms consists of bedsteads, dressing tables, bureaus, towel racks, wardrobes, and other convenient articles that taste and comfort may suggest. The best woods for such articles are, mahogany, cherry, black walnut, maple, and ash. The finish and design of each varying in accordance with the means of the individuals.

The expression of rooms devoted to sleeping and dressing should be cheerful without glare, and the best designers advise the use of neutral tints, and avoid great contrasts in color.

SURROUNDINGS OF A COUNTRY HOME.

In the erection of a farm house or country home, there is always a choice to be made in the location, and too much care cannot be exercised in selecting the site; a few feet in either direction may prevent damp cellars, and future malarial or typhoid fevers. Dry, gravelly, sandy, or rocky soils, that have not been built upon, are undoubtedly the best. Clay soils are objectionable on account of dampness, and made ground, composed of rubbish, should above all be avoided. The summit of a hill is too exposed, and the bottom of a hill too damp; hence a position midway between these extremes, or a gentle rise of ground, is to be preferred. A few trees, not so near as to exclude the light, will afford shade during the heat of summer, and protection from the winds in winter, besides relieving the barren surroundings of isolated houses. Trees, when well grown, should shade the ground about the house, not the house itself, and should never overhang or cast their shadows on the roof. Where the prevailing winds are violent, it will be well to plant a proper shelter belt of evergreens. While many evergreens will answer the purpose, the Norway spruce, on account of its rapid growth, its dense branching, and its perfect hardiness, is perhaps

best suited to this purpose. Instead of planting a single row of trees, where the land is abundant it is better to plant several rows. Set the first row ten feet apart, the second at the same distance, alternating with the first, and the third row alternating with the second. If space can be afforded for but a single row, a more immediate effect can be produced by planting the trees nearer together. The young trees may be set close, even only four or five feet apart, and alternate ones may be removed when they get large enough to crowd and interfere with each other. If regular rows are objectionable, the formality may be broken by planting a tree here and there to give the idea of a grove, rather than a shelter belt. In our climate a veranda is very desirable, both as protection from the sun in summer, and shelter from the storms in winter. Verandas can be supplied both at the front and back of almost any house, or at either side, at a very slight increase of the cost. These should be of ample dimensions, and if climbing vines are planted against the supports, they will add greatly to the comfort of the inmates, giving the exterior a tasteful and home-like appearance, not obtainable in any other manner. The common Virginia Creeper, or the climbing Bitter-sweet or Wax-work (*Celastrus scandens*) of the woods, will furnish most effective shade. Wistarias and other hardy vines may be had from the nurseries at a very small cost.

Such a residence should have, at least in front, a lawn of as great an extent as the locality will permit. A lawn, to be successful, needs a good soil. It is a mistake to throw out the earth excavated from the cellar and deposit it where the lawn is to be. A perfect level is not necessary or desirable in a lawn, as an undulating surface conveys the impression of a greater area than a level. Where terraces are necessary, they should be solidly made and turfed. Ornamental shrubs and trees of moderate growth, especially evergreens, may be planted with good

effect. It is becoming customary to do without a front and side fence where such a protection is not absolutely necessary; but if a fence must be used, an opportunity for displaying good or bad taste is presented in making the selection. Have the gates substantial and well hung. Set the posts firmly, especially those which support the gates, so that no sagging may occur. An edging of turf or box will embellish the walks, which should be laid only where necessary, and then as direct as possible. Great mistakes are often made in this matter of laying out walks and drives through an erroneous idea that convenience should be sacrificed to ornamentation.

DESIGN I.

A HOUSE FOR $100.

It often occurs in these days of preëmption and homestead rights, that a person having a very limited capital, wishes to construct a dwelling with the least possible outlay. To do this requires not a little tact, as well as a fair share of mechanical knowledge; and subsequently it may be conveniently used as the kitchen and dairy of the larger

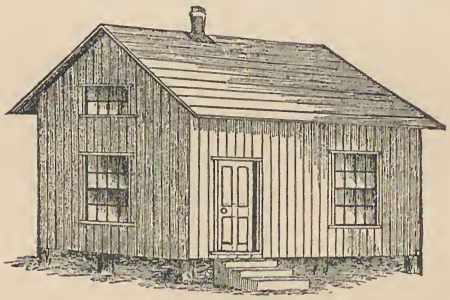


Fig. 1.—EXTERIOR OF HOUSE.

farm house, which will probably be needed in a few years. The writer has constructed and lived in such a house for several months. Though small, it afforded fair accommodations for five persons—three adults and two children. The size of the entire structure was twelve by eighteen feet, with walls twelve feet high. Figure 1 shows the exterior of the house. Figure 2 gives the lower story, consisting of a sitting-room nine and one-half by twelve feet, and a kitchen six and one-half by twelve feet. This allows two feet for stairway, with eight feet between floors, and stairs built as shown. There is room for a passage between the sitting-room and kitchen at one end, and for a closet at the other. Figure 3 shows a bedroom, nine

and one-half by twelve feet, and another eight and one-half by twelve feet. The latter, when not needed for a

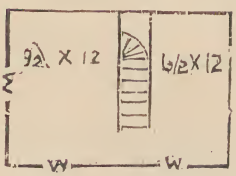


Fig. 2.—FIRST FLOOR.

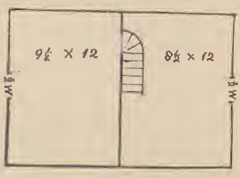


Fig. 3.—UPPER FLOOR.

bedroom, can be used as a store-room. This upper story is lighted by a half window in each end of the house.

COST OF MATERIALS AND LABOR.

3 pieces, 2 by 4 inches, 18 feet long, for sills for foundation.
9 pieces, 2 by 4 inches, 12 feet long, for floor joists.
26 pieces, 1 by 6 inches, 18 feet long, for floor.
36 pieces, 1 by 12 inches, 12 feet long, for two long walls.
8 pieces, 1 by 12 inches, 14 feet long, for ends.
8 pieces, 1 by 12 inches, 16 feet long, for ends.
8 pieces, 1 by 12 inches, 18 feet long, for ends.
35 pieces, 1 by 4 inches, 12 feet long, for battens for long walls.
8 pieces, 1 by 4 inches, 14 feet long, for battens for ends.
8 pieces, 1 by 4 inches, 16 feet long, for battens for ends.
8 pieces, 1 by 4 inches, 18 feet long, for battens for ends.
2 pieces, 2 by 4 inches, 18 feet long, for upper long plates.
2 pieces, 2 by 4 inches, 12 feet long, for upper end plates.
2 pieces, 2 by 4 inches, 18 feet long, for plates for upper floor.
9 pieces, 2 by 4 inches, 12 feet long, for joists for upper floor.
26 pieces, 1 by 6 inches, 18 feet long, for upper floor.
7 pieces, 2 by 4 inches, 18 feet long, for rafters.
20 pieces, 1 by 4 inches, 12 feet long, for sheathing.
10 pieces, 1 by 4 inches, 14 feet long, for sheathing.
4 pieces, 1 by 12 inches, 14 feet long, for partition above and below.
4 pieces, 1 by 12 inches, 16 feet long, for partition above and below.
4 pieces, 1 by 12 inches, 18 feet long, for partition above and below.
9 pieces, 1 by 12 inches, 12 feet long, for side wall of stairs.
2 pieces, 1 by 12 inches, 12 feet long, for stiles for stairs.
2 pieces, 1 by 12 inches, 12 feet long, for steps for stairs.
2 pieces, 1 by 4 inches, 18 feet long, for scrub-board.
4 pieces, 1 by 4 inches, 12 feet long, for scrub-board.
Assorted, 72 feet for door and window casing.
Assorted, 36 feet for foundation.

The lumber at the ruling prices in California would now cost	$65.00
Shakes (split boards)	7 50
1 door, $1.60; 2 windows, at $2, $4; 1 window, $2.75	8.35
1 lock and 1 pair hinges, 65 cents; nails, $4.50	5 15
Lining cloth, $2.50; lining tacks, 50 cents; wall paper, $1	4.00
Total	$90.00

The ten dollars to make up the amount mentioned, will allow for any minor changes that may make the plan conform to the desires of the builder; or, in the event of extra hire or freight-bills, this amount will be correct.

The plan and estimate here given presuppose that the owner does his own work. There is no particular skill required. Even these figures may be cut down, as old lumber can sometimes be procured for foundation and braces. Sheathing should project six inches at the ends of the building. Strips, one by four, nailed between pieces of sheathing, and lengthwise of the rafters, will make the upper story tight enough for comfort.

DESIGN II.

PIONEER'S HOUSE, COSTING $473.

The plan here given, if carried out as described, will make a convenient small house of very fair appearance. But by the use of rough covering, simple building-paper walls inside instead of plastering, to be afterwards better covered and plastered, and by other economies, the first cost may be reduced to two hundred and fifty or three hundred dollars. This first, rough method we have seen adopted by multitudes of prairie "homesteaders" in limited or straightened circumstances.

It will be noticed that the construction provides for prairie or other locations where stone or brick are not to be obtained, except from a distance, at large expense. Some omit the chimney, at first, and depend for a year or two upon a simple stove-pipe, carried through an earthen thimble in the roof. Where stone or brick are accessible, these may be used for the foundation pillars instead of the wooden posts. But almost any kind of wood will last several years, and some kinds for many years. If the least durable wood be used, stone or brick

supports can be put in when decay takes place. So, also, the cellar can be fully excavated, and, if need be, walled up, when the circumstances of the builder permit.

ELEVATION.—The general plan accords with the usual custom on the broad prairies and other localities exposed

Fig. 4.—PERSPECTIVE VIEW.

to strong winds and hurricanes, viz., to build only a story and a half, and to have the "family bedroom" on the first floor. A very little more expense would give higher rooms in the second story, and another room over the kitchen. The house has a rather pleasant look. Any mechanic of fair ability can vary the gables and other

features, and give the "L" a double pitch, at little or no expense, so as to produce pleasant changes in the appearance.

First Story. — The size and arrangement of the rooms are sufficiently shown in the engraving. The rooms are planned to save steps and facilitate work.

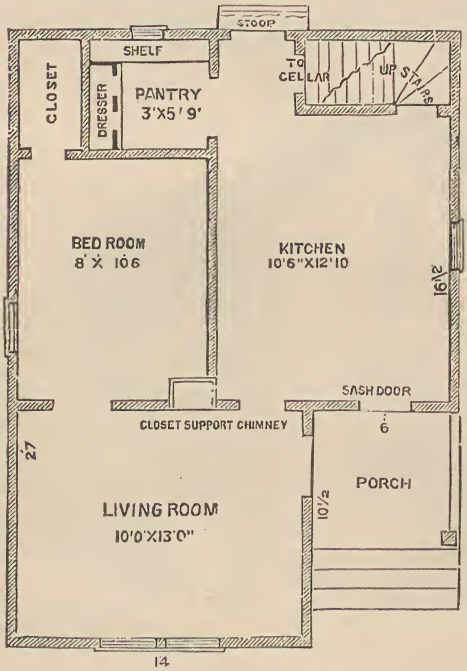


Fig. 5.—FIRST FLOOR.

The "living-room" serves also as a parlor, and possibly as dining-room on formal occasions, if such occur, and is entered from the porch. The chimney, starting two feet below the second floor, can be directly reached by a stove pipe from every room. A small closet is placed under it.

SECOND STORY.—This has but two rooms. If there are several small children, the larger room will bear partial dividing with boards, or curtains, or the two may be arranged as three. Raising the side walls two feet higher, would allow this to be done very readily. The small storage room under the lower roof can be reached

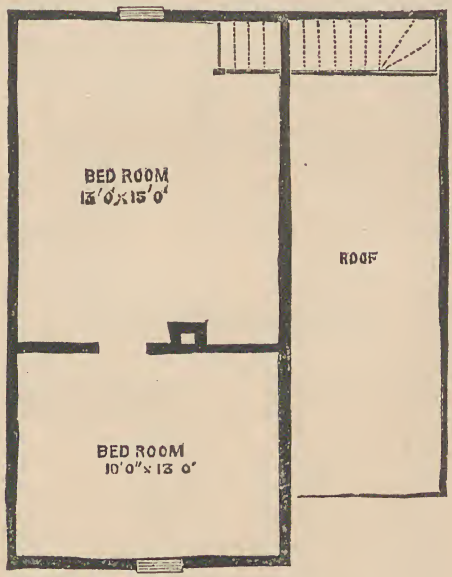


Fig. 6.—SECOND FLOOR.

from the stairs, or by a small door from the larger bedroom.

CELLAR AND FOUNDATION.—In the absence of stone or brick, or for economy, the sills are to be supported by wooden posts, six to six and one-half feet long, and eight inches square; or rough logs hewn flat on two sides may be used. The posts are set as shown in the plan, four to four and one-half feet in the earth, and about two feet above grade. For a small cellar, begin two feet

from the inner side of the posts and take out the earth, leaving the sides sloping inwards at an angle of about forty-five degrees, according to the kind and compactness of the soil, and deep enough to give seven feet below the floor. The posts are to be boarded up on the outside tightly, and lined on the inside with tarred building paper. The paper at all corners is to be turned out upon

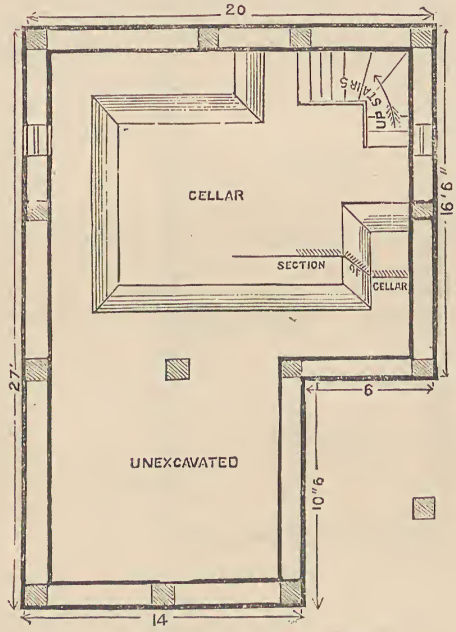


Fig. 7.—FOUNDATION AND CELLAR.

the posts and secured firmly to them with lath strips nailed vertically over the paper. Then board up on the inside over the paper, and fill the space between the walls with straw or else prairie hay, dry and well packed in. Bank against the exterior with the excavated earth, and grade off to throw water well away from the building. Provide a small window on each side for light and

ventilation. For sills, use two by eight inch joists double, and set on edge, two inches smaller than foundation, on all sides. Nail one by two inch ribs on bottom edge of sills, for joist bearings, and notch joists accordingly. All floor joists are two by eight inches, set sixteen inches apart at centers, well spiked in position.

FRAME, ETC.—For frame, siding, boarding, etc., use two by eight inch plank, fifteen feet long, of even length on main sides, set perpendicularly flatways, the edges

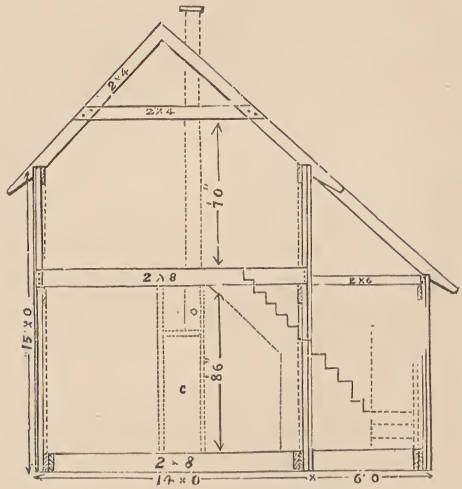


Fig. 8.—SECTION OF FRAME, ETC.

close together to make a close wall; spike to the outside of the sills, the lower ends even with the bottom edges of the sills. Just under the second floor joist-bearing, set a rib one by six inches; just above this cut a notch into one edge of every other wall plank for the end of a joist, and spike the joist firmly in. As the upright planks are eight inches wide, this will bring the joist centers sixteen inches apart. At the top of the wall planks, nail on the inside a one by ten inch strip

forming a frieze, extending two inches above the wall plank. Notch the rafters into this piece so that their top edges will be even with its upper edge, and the roof boards can be nailed to it, thus closing all tightly here. This strip constitutes the plate. The rafters (and roof) should extend over the side fifteen to eighteen inches, the ends being tapered and dressed.

The cornice is formed with roof boards dressed on the under side and outer edge, and nailed upon the beveled ends of the rafters; gable finished in same manner, with verge boards, as shown. The rafters of two by four inch stuff, sixteen inches apart at centers, with collar beam to each rafter of two by four inches. Plank up the gable ends the same as the side walls. Batten (plain or molded) all joints of planking. Window casings to be set on over planking, all properly flashed over with tin. Frame the porch as shown in figures 4 and 8. Pitch floor to front. Lay floors, and ceil overhead with narrow matched boards. Case the corner-post to form a column. With saw and augur form the soffit finish as shown. The verge boards are formed in like manner, or to suit taste of builder or owner.

While the house can be built very cheaply by using rough materials, a little extra cost will dress and paint all the exterior to suit the taste, desire, or means of the owner. It is intended, after lining the inside with tarred or resin-sized paper, to fur off with one by two inch strips, and lath and plaster. Doors paneled. Eight-light windows. Generally plain finish throughout. The plans, figures 5 and 6, show the rooms and other interior arrangements.

COST OF MATERIALS AND LABOR.

TIMBER AND LUMBER: 12 foundation posts, 6½ feet, 8 by 8 inches; boards for foundation, 500 feet; ten pieces 10 feet, 2 by 8 inches; eighteen pieces 16 feet, 8 by 8 inches; twenty-eight pieces 14 feet, 2 by 8 inches; eight pieces 12 feet, 2 by 8 inches; seventy-four pieces 10 feet, 2 by 4 inches; ten pieces 12 feet, 2 by 4 inches; thirty pieces 18 feet, 2 by 4 inches; one hundred and sixty

pieces 46 feet, 2 by 8 inches. Roof boards 500 feet. Battens 2 inches wide (3,000 feet length), 500 feet. 1-inch furring, 400 feet board measure.

Total, 7,989 feet, at $15	$119.83
1,000 feet flooring, at $18	18.00
7,000 shingles, at $3.50	24.50
200 yards plastering, at 20 cents	40.00
10 doors and frames, at $4	40 00
7 windows and frames, at $4	28.00
Base, pantry, closets, etc	15.00
Stairs, $10; chimney, $13	23.00
2 coats paint, $60; 3 kegs nails, $12	72.00
LABOR: Excavation and foundation, $15; labor on frame, $30; laying floors, $6; shingling roof, $12; setting doors and windows, $20	83.00
Sundries, say	10.00
Total cost	$473.33

DESIGN III.

A COUNTRY HOUSE, COSTING $724.43.

The estimate of cost is probably too low for average localities. The rooms are rather small. A trifle more expense would add to the size and hight, and largely increase the convenience of the rooms—a foot additional would make much difference in this respect. The cellar would be better to go under the whole house, as the excavating would be but a trifle, and the extra cross foundation would cover part of cost of extending the side foundation down to full depth. Giving the stairs a turn, would save room in both the lower and upper halls. The building is a balloon frame. The studs, floor, joists, rafters, and collar joists are placed sixteen inches from centers; sills, six by eight inches, framed together; floor joists gained in and studding tenoned into sills. Corner, door, and window studs, four by four inches; other studding, rafters, and collar joists, two by four inches; floor joists, two by eight inches, and bridged. All of good timber, and well nailed. The frame is boarded on the inside with mill-worked boards, well nailed, and covered with felt paper, and furred off with lath, placed sixteen inches

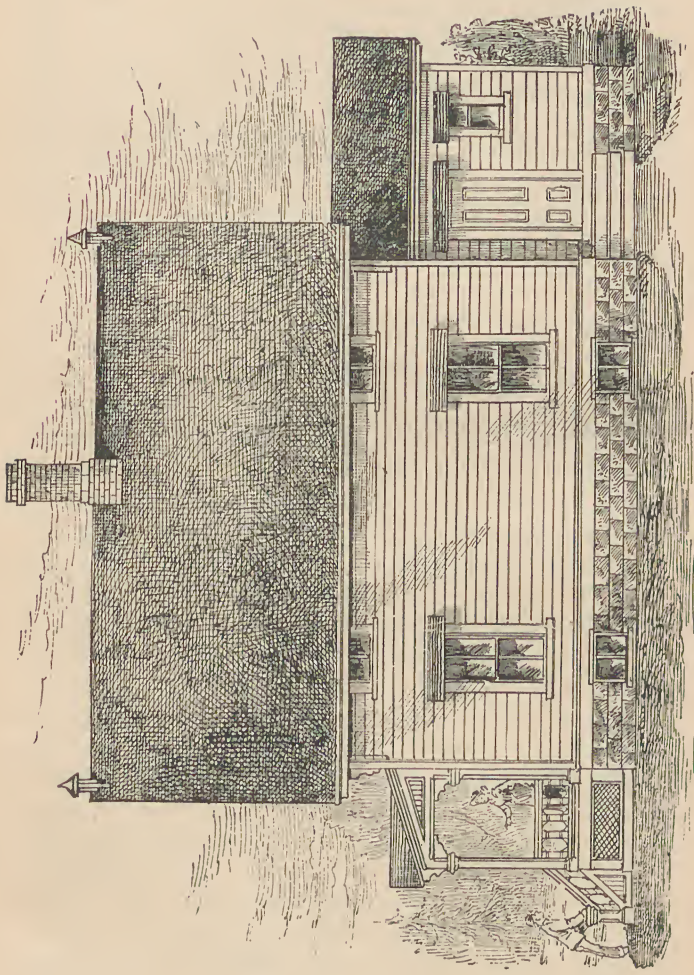


Fig. 9.—SIDE ELEVATION OF COTTAGE.

from centers. The outside is covered with a good quality of six-inch clapboards. The floors are covered with good mill-worked pine or spruce boards, six inches wide. The roof is boarded with mill-worked boards, and covered

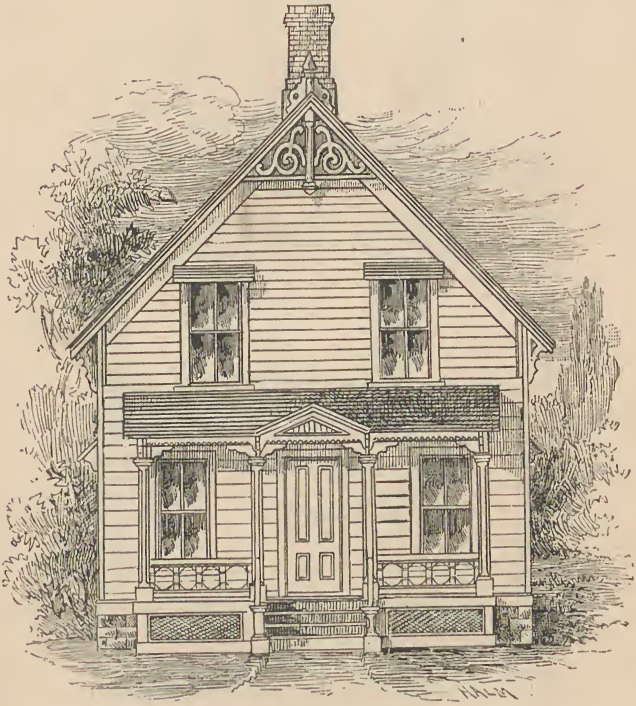


Fig. 10.—FRONT ELEVATION OF COTTAGE.

with best eighteen-inch shingles, laid five inches to the weather. The windows in the lower story have four lights each, fourteen by thirty-inch glass; in second story, four lights each, fourteen by twenty-eight-inch glass; frieze windows, two lights each, fourteen by sixteen inches; cellar windows, two lights, fourteen by fourteen, double glazed. Cellar windows are

hinged at their tops. All windows to have suitable fastenings. The front door is two feet eight inches by

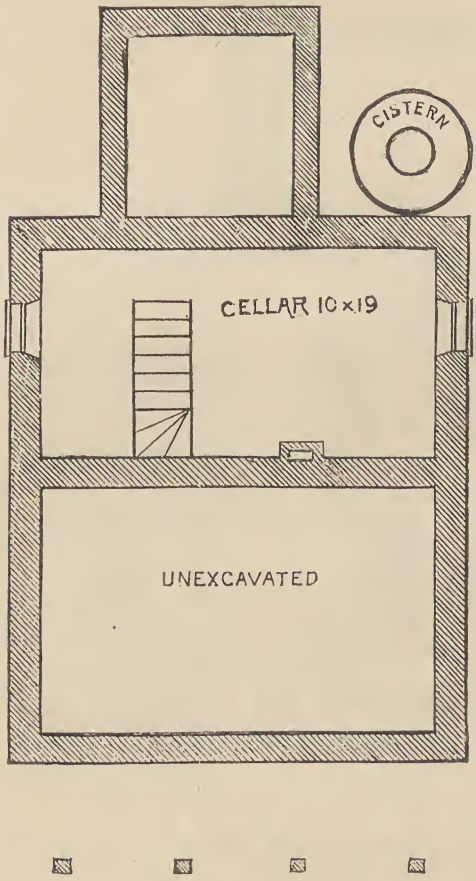


Fig. 11.—PLAN OF CELLAR.

seven feet, one and three-quarters inch thick; closet doors, two feet by six feet six inches; cellar door, two feet six inches by six feet eight inches; other doors, two

feet eight inches by six feet eight inches, and one and three-eighths thick, hung with three and one-half inch

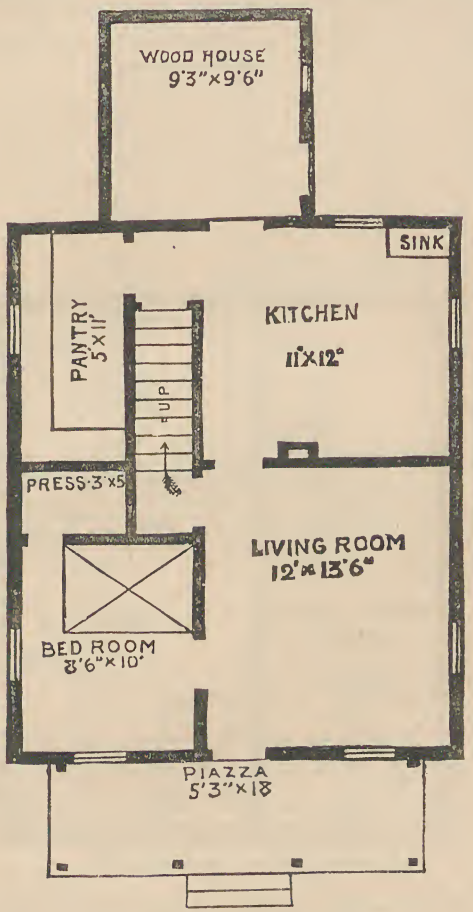


Fig. 12.—PLAN OF FIRST STORY.

loose pin-butts. Outside doors are provided with locks; other doors, mortise latches, all trimmed with porcelain knobs, and japanned furniture. The casings are five

inches wide, moulded edge; first story to have band mouldings and mouldings on base; second story, beveled casings and base; kitchen to be wainscoted three feet high. The stairway has easy risers and treads, and

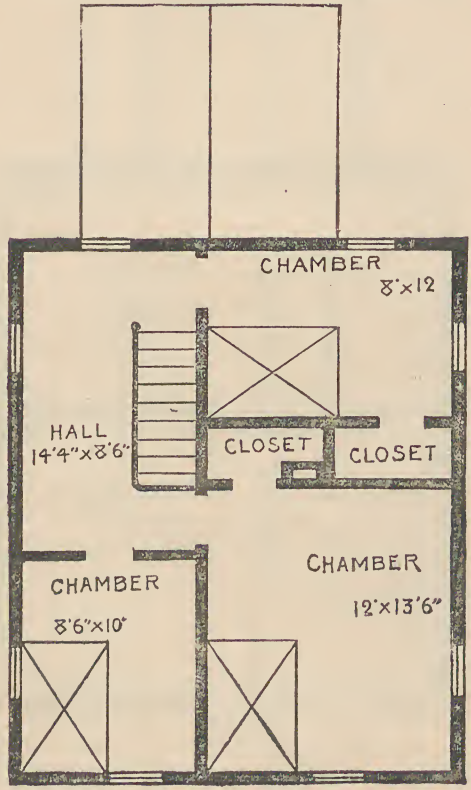


Fig. 13.—PLAN OF SECOND STORY.

is made substantial. It has turned newel post and balustrade. The cornice is provided with suitable gutters and leaders to carry the water into the cistern. Stairs lead to the cellar, made of two-inch plank. A cast-iron sink is set in the kitchen, inclosed with door underneath

and provided with waste pipe. A suitable pump is provided. All woodwork usually painted has two coats of best white lead and oil, as a basis, with such colors as may be chosen.

The cellar is excavated as shown in the plan, with trenches dug below frost, and leveled off. Cellar walls and foundations are of field stone properly faced, and laid in lime and sand mortar. The joints are pointed, and the cellar made six and one-half feet high. A cis-

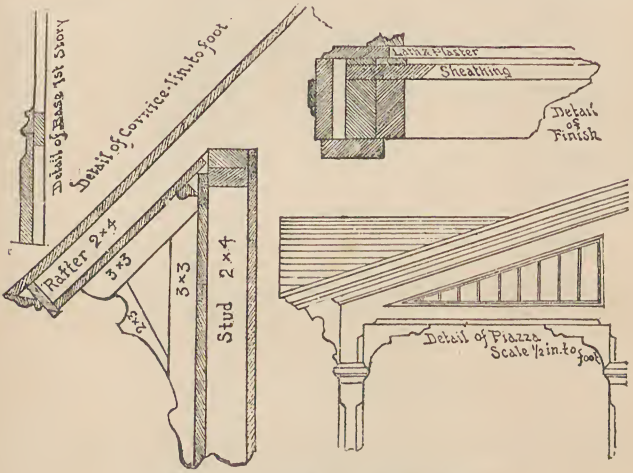


Fig. 14.—CORNICES, FRAMING, ETC.

tern is excavated six feet in diameter by nine feet deep, arched over with brick with suitable man-hole and openings for inlet and outlet pipes; the whole interior thoroughly plastered with water-lime mortar; overflow pipe laid of tile below frost. The chimney is laid of brick, starting on bottom of cellar, with all necessary openings of stove pipe provided with thimbles. The first and second stories are lathed and plastered with one good heavy coat of brown mortar; the side walls troweled smooth and the ceilings hard-finished.

COST OF MATERIALS AND LABOR.

2 sills, 6 by 8 inches, 26 feet long.	20 joists, 2 by 8 inches, 22 feet long.
3 sills, 6 by 8 inches, 22 feet long.	75 pieces, 2 by 4 inches, 14 feet long.
3 sills, 6 by 8 inches, 10 feet long.	75 pieces, 2 by 4 inches, 16 feet long.
16 joists, 2 by 8 inches, 14 feet long.	100 pieces, 2 by 4 inches, 18 feet long.
16 joists, 2 by 8 inches, 12 feet long.	18 pieces, 4 by 4 inches, 14 feet long.

Total, 4,759 feet, at $14	$ 66.63
3,000 feet roofing and sheathing, at $12	36.00
2,000 feet siding, at $18	36.00
2,000 feet finishing stuff, 1 inch, best common, at $25	50.00
500 feet finishing stuff, 1¼ inch, at $30	15.00
300 feet finishing stuff, 2 inch, at $20	6.00
1,600 feet flooring, at $18	28.80
200 feet wainscoting, at $25	5.00
8,000 shingles, at $3.50	28.00
14 doors, at $1.75 each	24.50
12 windows, at $1.75 each, $21.00; 6 frieze and cellar windows, at $1 each, $6	27.00
500 feet mouldings, at 2½ cents per foot	12.50
50 perches stone work, at $1	50.00
1,300 bricks laid in chimney, at $12	15.60
275 yards plastering, at 18 cents per yard	49.50
100 lbs. tarred felting, at 5 cents	5.00
Nails, trimmings, etc	35.00
Gutters and leaders	10.00
Cistern, pump, and sink	25.00
Carpenter work	125.00
Painting and material	60.00
Excavating, etc	15.00
Total Cost of House	$725.53

DESIGN IV.

A COTTAGE COSTING $1,500

This simple and unpretentious design has seven rooms with all necessary halls and closets. The building was erected for a small family, and makes an excellent farm residence. There is a cellar under the hall and parlor only.

The hight of the cellar is six feet six inches; of the first story nine feet; and of the second story eight and one-half feet. The cellar is excavated to a depth of three feet, and the loose earth used in grading about the walls at completion, so as to leave two and one-half feet of the foundation exposed. The foundation walls and chimneys are of hard brick, laid in cement mortar to the top of the ground; to be laid in best lime mortar from thence, except chimney tops, which are also to be laid in cement.

All with close joints, washed down with dilute acid and stained with linseed oil and Venetian red—flues separate from each other to the top, with all required thimbles set in the brick-work. Blue-stone sills and coping are pro-

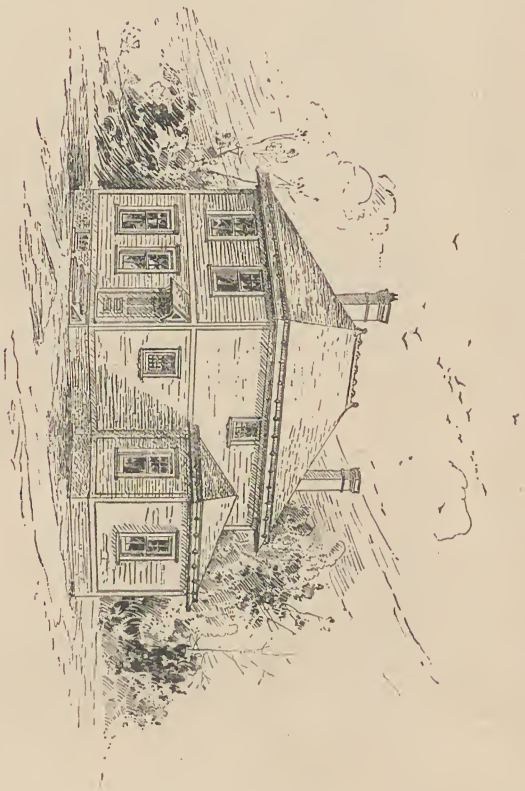


Fig. 15.—PERSPECTIVE VIEW OF COTTAGE.

vided and set in cellar windows and area. The inside walls and ceilings are hard-finished on two coats of best brown mortar and seasoned lath, and all angles made solid and true. A brick cistern six feet in diameter and eight feet deep, is built in the rear of the house, with vitrified

earthen drain connected with the leader; has an overflow pipe, domed top and flagstone cover, and bottom plas-

Fig. 16.—FRONT ELEVATION.

tered on the inside with Portland cement; and has a proper filter.

The framework of the house is of sound, seasoned spruce timber, framed, raised and braced in a se-

Fig. 17.—REAR ELEVATION.

cure manner. The floor beams and studding are sixteen inches from centers; the rafters twenty inches from centers. Each tier of beams is thoroughly bridged with one row of cross-bridging placed in the middle of each span. Headers and trimmers about stairs

and chimney breasts are to be of double thickness. The exterior walls and roofs are sheathed with one inch, dry, surfaced lumber; the side walls are papered, and clapboarded with clear, white pine beveled clapboards, and the roofs shingled with best cut white pine shingles. The lower ends of rafters are dressed and exposed to view,

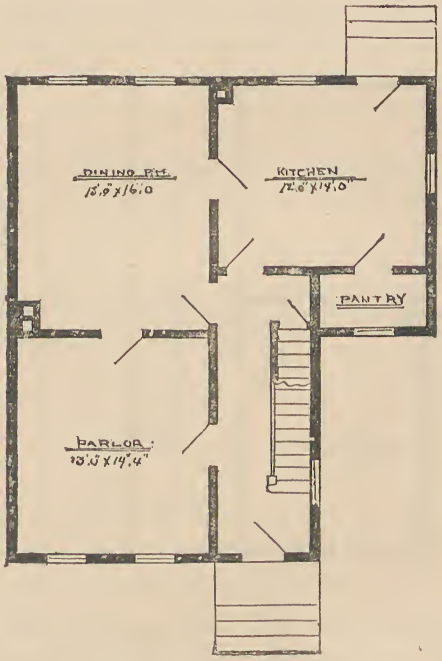


Fig. 18.—FIRST STORY.

the cornice formed by nailing tongued and grooved roofing boards upon the upper side, with the surfaced side down, with a neat moulding at lower ends of rafters. The hood over the front door, corner boards, belt and base courses, gutters, outside steps, cresting and finials are all of white pine, as shown on the drawings. The cellar window frames are of plank; all others have one and

one-eighth inch jambs and blind-hanging stiles, two-inch rabbeted sills, and one and one-half inch sashes, all of dry, white pine. The sashes are glazed with double thick glass and balanced with weights, with the exception of windows in the hall, which are hinged. All windows have outside blinds of white pine.

The floors throughout are of good quality, seven-eighths by four inch tongued and grooved mill-worked white pine,

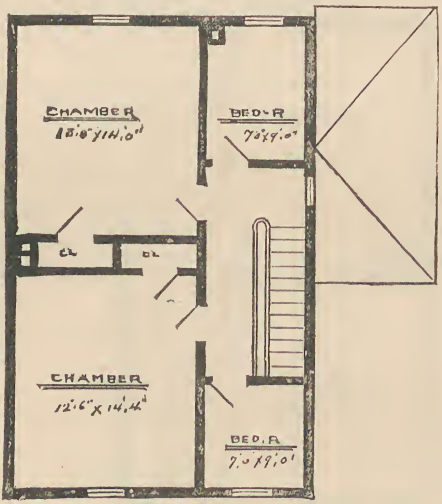


Fig. 19.—SECOND STORY.

driven well together and blind-nailed to each bearing. The cellar stairs are of plank. The main stairs are of clear pine with six-inch turned ash newel, and one and one-half inch balusters, with a three by four inch rail. The door jambs are one and one-eighth inch thick, with stops planted on, moulded architraves, turned corner blocks, plain plinth blocks, and wall mouldings to mitre with top member of base. Beveled hard-wood saddles are put to each door, with rubber-tipped door stops where required. Pantry is fitted with four shelves and one dozen

hooks. Wardrobe closets have one shelf and one dozen black japanned iron hooks. The doors are of seasoned clear white pine, paneled and moulded both sides, except the closet doors, which are moulded one side only. The outside doors are two inches thick, glazed as shown. Closet doors are one and one-quarter inch thick, all other doors one and one-half inch thick. All to be hung with heavy, loose-joint, japanned iron butts, with brass-faced mortise locks, brown mineral knobs and suitable roses, drops and escutcheons; front door lock has night latch and black porcelain knob and bronze rose, drop and escutcheon.

All outside and inside woodwork, and outside metal work have two good coats of white lead paint, all knots covered with shellac, and other defects stopped with putty before painting. The colors outside are in shades of brown, inside work as directed at time of painting. A suitable galvanized iron kitchen sink and suction pump, properly connected with the cistern, is placed in the kitchen. All flashings, leaders and linings of gutters to be of I. C. charcoal tin.

COST OF MATERIALS AND LABOR.

50 cubic yards excavating, at 30 cents	$ 15.00
214 feet stone footings, at 20 cents	42.80
13,000 bricks, furnished and laid, at $16	208.00
40 feet bluestone sills, steps, and coping, at 30 cents	12.00
450 square yards plastering, at 35 cents	157.50
5,500 feet framing timber, at $15	82.50
4,000 feet hemlock sheathing boards, at $17	68 00
12,000 shingles, at $5	60.00
150 pounds sheathing paper, at 4 cents	6.00
1,200 feet finishing white pine lumber, at $5	60.00
2,000 feet white pine tongued and grooved flooring, at $27	54.00
432 white pine clapboards, at 20 cents	86.40
1 cellar window, complete	3.00
2 casement windows, at $3.25	6.50
10 windows, complete, at $4	40.00
11 doors, complete, at $4.25	46.75
3 doors, complete, at $4	12.00
1 door, complete	6.00
5 kegs nails, at $3	15.00
Carpenter work and labor	300.00
Stairs, complete, $30.00; Pump and sink, complete, $12.00	42.00
Hardware, not included above, $20.00; Tinwork and leaders, $25.00	45.05
Cartage, $15.00; Painting, $75 00	90.00
Cistern, $30.00; Incidentals, $11.50	41.50
Total	$1,500.00

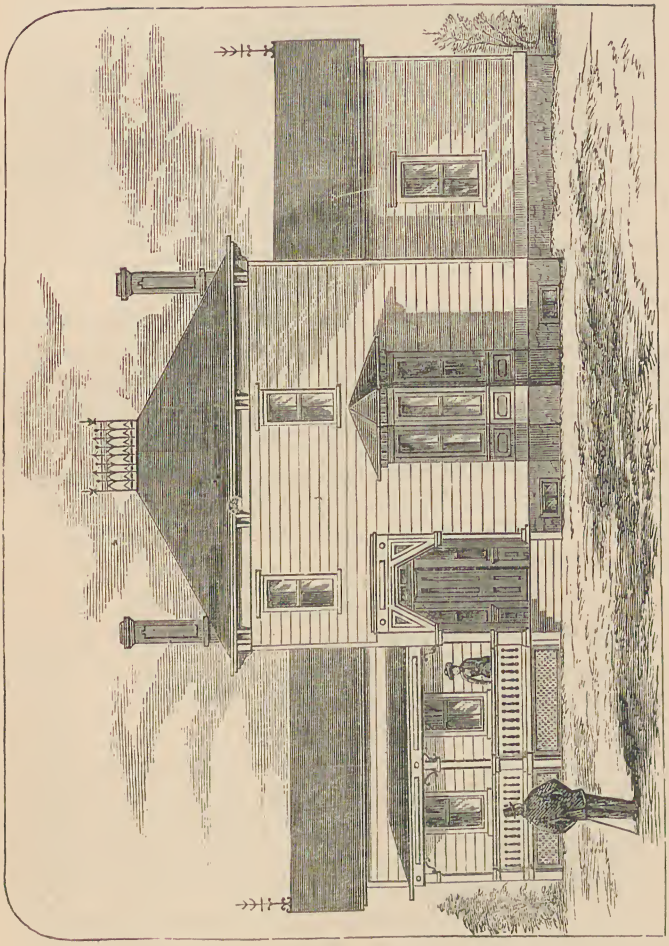


Fig. 20.—FRONT ELEVATION.

DESIGN V.

COUNTRY HOUSE, COSTING $1,900.

The features aimed at in this plan will please housekeepers, viz.: First, to have the living or sitting-room

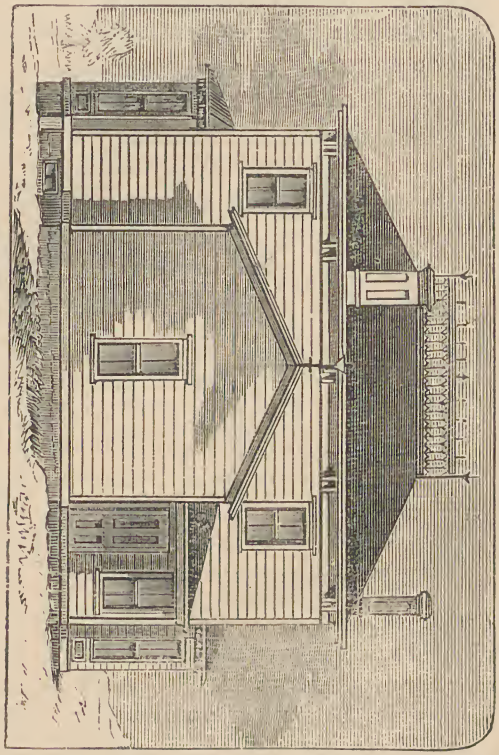


Fig. 21.—SIDE ELEVATION.

located near the center, and convenient to all other parts of the house; second, to have the kitchen and dining-room so connected as to save steps; third, to have the size of the floors of all carpeted rooms in even yards, at least in one dimension. The designer—a practical farmer

—mentions incidentally that he made the first draft over a year before building, and this is the result of a full year's studying and thinking over it. The cost as here shown and described, figures up $1,900. It is evident that by some changes and omissions, and by cheaper finish at first, the cost may be reduced to $1,600, or even to $1,500 where building materials are moderate in price; while a few extras, outside and inside, will easily raise the cost to $2,000 or even more.

The Front Elevation and the Side Elevation exhibit a fair looking exterior. The bay-window in front,

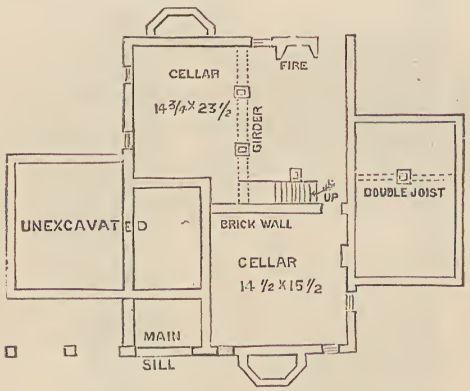


Fig. 22.—CELLAR PLAN (REDUCED SCALE).

if made nine feet wide, instead of six, would show better, we think, and materially enlarge the sitting-room, allowing two or three persons to set their chairs within it for an outlook, while the expense would be but a trifle more, mainly for wider panes of glass. As there is, or may be, a large side window in the dining-room, the rear bay-window might be omitted, and save that expense, unless the number to be accommodated at the table makes the elongation of the table room space desirable; or unless there be some unpleasant object in view from the side

window, making it desirable to keep that window or its lower sash curtained. But we always favor all the bay windows that can be attached to a house without injuring its general appearance, or too greatly increasing the cost; they furnish more light, permit looking out in three direc-

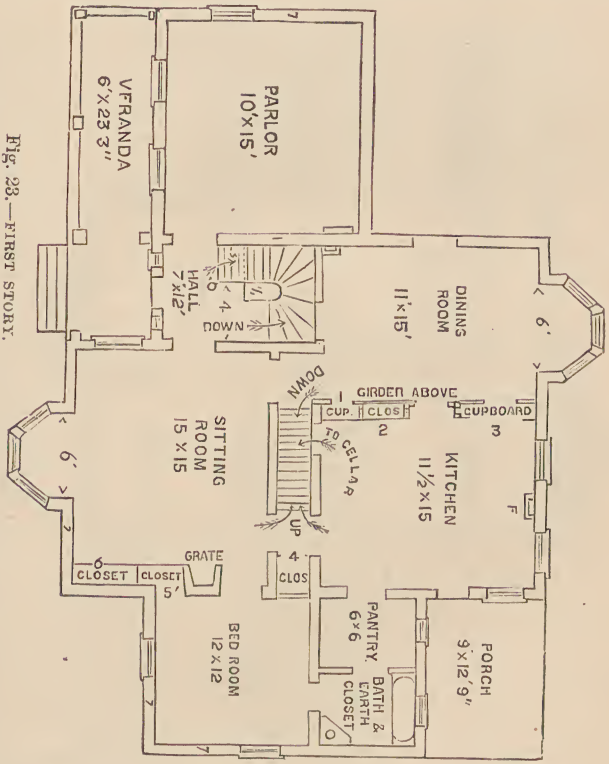


Fig. 23.—FIRST STORY.

tions, and enlarge the floor space proportionally more than the square feet of floor added. There is probably as much room in this house as would be needed by most families, but two large bed rooms or store rooms could be secured at small cost, by raising the wings—one or both—to nearly full hight. As the flooring, roofing, cornices, etc., would

be the same, the extra cost would be only the floors, ceiling, and the walls of the additional rooms, and the extra timber and siding. This applies to all houses. On the prairies and other places exposed to hurricanes, it is usually thought necessary to keep buildings as low, and

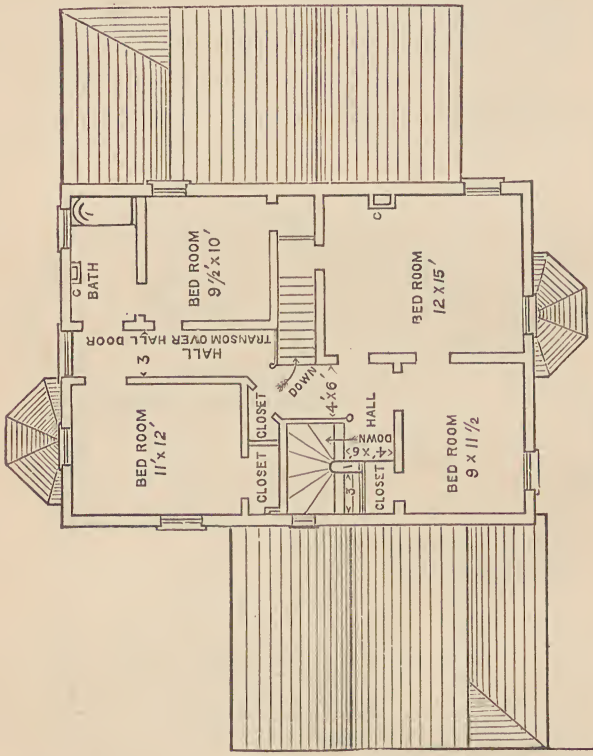


Fig. 24.—SECOND STORY.—ROOFING OF FIRST STORY.

to give them as broad a base as possible. Mr. Swartz writes: "All outside walls should be sheathed on the inside of studding with boards having the heavy ship-lap and then lathed and plastered." The outside is covered with narrow clapboards (*c*, fig. 25). For cold localities, a lining under these of tarred paper, or roofing paper,

will add materially to the warmth of the house, and not greatly increase the expense. The saving of fuel will pay the cost of such paper in a very short time.

THE BASEMENT.—This is divided, by a brick wall, into the cellar in front, and a rear room with fire-place, for butchery, soap-making, and other rough work in bad weather. It may be fitted for a laundry or washing room, but needs more window light if it is to be much used. The cellar room may be ample, but the unexcavated space can be made available by a little more expense in continuing the foundation walls three or four feet lower and taking out the earth.

FIRST STORY, OR GROUND PLAN.—Hight, nine feet. The arrangements, divisions, etc., are plainly shown in figure 23, with the convenient connecting doors, etc. Closets and cupboards on first floor: Number 1, in dining-room, lower part for table linen, upper part for table ware not in common use; 2, cook's kitchen wardrobe; 3, china and service cupboard, with scullery below; 4, for mens' and boys' boots and rough clothes; 5, bedroom closet, with shelves above and hooks under them; 6, may have drawers below; pantry, furnished with shelves and flour and meal boxes. Bath on first floor, with water pipes from range and cistern. We think that, as there is a bath-room above, this lower one may be omitted, unless needed by an invalid, and its space be in part added to the pantry, and in part to the bedroom as a closet, of which there can hardly be too many in any house. Besides, it is not safe to have such a room with its earth closet opening into the pantry. The parlor is rather small, but perhaps sufficient for all ordinary purposes A foot or two larger, one or both ways, would not add greatly to the expense: besides, twelve by

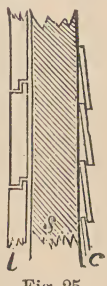


Fig. 25.
WALL SECTION.

fifteen or twelve by eighteen, would make the yards come right, which the designer justly deems of importance. There should be another window on the side or rear, as the two front windows are darkened by the veranda roof. It would be convenient to have the front windows extend down to the floor, but this would increase the expense. For a physician, or justice of the peace, the first-story bedroom might be used as an office, making a door of the front window, with steps—perhaps adding a veranda.

SECOND STORY.—Hight, eight and one-half feet. Figure 24 shows the arrangement. The smaller front bedroom might have six to twelve inches more room,

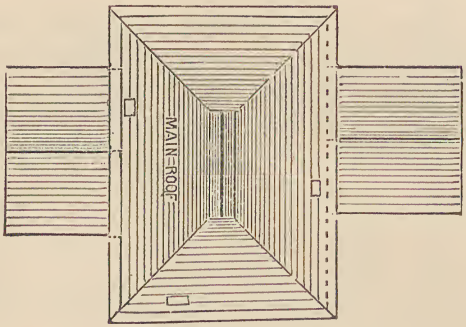


Fig. 26.—PLAN OF ROOF (REDUCED SCALE).

taking it from the hall. There is no way to heat this room, but all others have chimney flues for stove-pipes; the one from the eleven-by-twelve bedroom will have to enter the chimney through the closet. The heating throughout the house is by grates and stoves. The foul air escapes through ventilators or perforated base, to the space between the sheathing-boards and the siding, and thence to ventilators in the roof. Construction :—The joists are to be strongly bridged; all work to be first-class of its kind. All work plain, except parlor and sitting-room. The materials described will show the character

of the work. The prices named appear to be about the average through the country generally. Common labor is reckoned at one dollar to one dollar and twenty-five cents per day; skilled labor, one dollar and a half to two and a half.

COST OF MATERIALS AND LABOR.

Sills, Girders, Posts.

6 pieces, 6 by 8 inches by 14 feet, 336 ft.
3 pieces, 6 by 8 inches by 16 feet, 192 ft.
4 pieces, 6 by 8 inches by 18 feet, 288 ft.
2 pieces, 6 by 8 inches by 20 feet, 160 ft.
2 pieces, 8 by 8 inches by 6 feet, 64 ft.
1 piece, 6 by 6 inches by 6 feet, 18 ft.
1 piece, 8 by 8 inches by 8 feet, 43 ft.
3 pieces, 4 by 4 inches by 8 feet, 32 ft.
1,133 ft.

Rafters.

4 pieces, 3 by 6 inches by 20 feet, 120 ft.
2 pieces, 3 by 6 inches by 18 feet, 54 ft.
14 pieces, 2 by 4 inches by 10 feet, 93 ft.
34 pieces, 2 by 4 inches by 12 feet, 272 ft.
48 pieces, 2 by 4 inches by 16 feet, 512 ft.
1,051 ft.

Stud Partitions.

70 pieces, 2 by 4 inches by 9 feet, 420 ft.
60 pieces, 2 by 4 inches by 10 feet, 400 ft.
820 ft.

Outside Studs.

3 pieces, 4 by 4 inches by 20 feet, 80 ft.
4 pieces, 4 by 4 inches by 12 feet, 64 ft.
57 pieces, 2 by 4 inches by 20 feet, 760 ft.
6 pieces, 2 by 4 inches by 16 feet, 64 ft.
4 pieces, 2 by 4 inches by 14 feet, 37 ft.
55 pieces, 2 by 4 inches by 12 feet, 440 ft.
1,445 ft.

Joists.

36 pieces, 2 by 8 inches by 12 feet, 576 ft.
8 pieces, 2 by 8 inches by 14 feet, 149 ft.
9 pieces, 2 by 8 inches by 15 feet, 180 ft.
25 pieces, 2 by 8 inches by 16 feet, 533 ft.
7 pieces, 2 by 8 inches by 18 feet, 168 ft.
1,606 ft.

Ceiling Joists.

40 pieces 2 by 4 inches by 12 feet, 320 ft.
26 pieces, 2 by 4 inches by 16 feet, 277 ft.
12 pieces, 2 by 4 inches by 20 feet, 160 ft.
757 ft.

Total, 6,812 feet board measure, at $22 per 1,000 feet..... $149.86

2,500 feet flooring, at $30	75.00
20,000 shingles, at $2.85	57.00
2,600 siding, at $22	57.20
2,200 feet ship-lap sheathing, at $22	48.40
65 shingle lath, at 8 cents	5.20
1,400 feet of inch boards, at $30	42.00
520 feet of inch boards, at $20	11.00
4 windows and blinds, complete, at $8	32.00
13 windows and blinds, complete, at $7.40	96.20
3 windows and blinds, complete, at $2.50	7.50
2 bay-windows (complete, excepting framing and roof)	50.00
6 cellar windows, at $1.30	7.80
4,200 bricks, laid, at $11.50	48.30
1,540 feet stone work, at 7 cents	107.30
150 cubic yards of excavation, at 18 cents	27.00
250 feet of spouting, at 10 cents	25.00
Doors, complete: one front, $18; nine at $6 each; five at $7 each; two at $6.25 each; thirteen closet doors at $2.50 each	152.00
Pantry, finished, complete, $14; 2 cupboards, do, $12	26.00
Closet shelving and hooks	13.90
Stairways: Main, $28; rear, $10.50; cellar, $4	42.50
Plastering, 675 square yards, complete, at 25 cents	168.75
Cresting and finials	30.00
Painting, $130; nails, $30	160.00
Range, baths, and fixtures	110.00
Carting not included in above	36.00
Carpenter work not in above estimates	275.00
Sundry incidental expenses	39 09
Total cost of building complete	$1,900.00

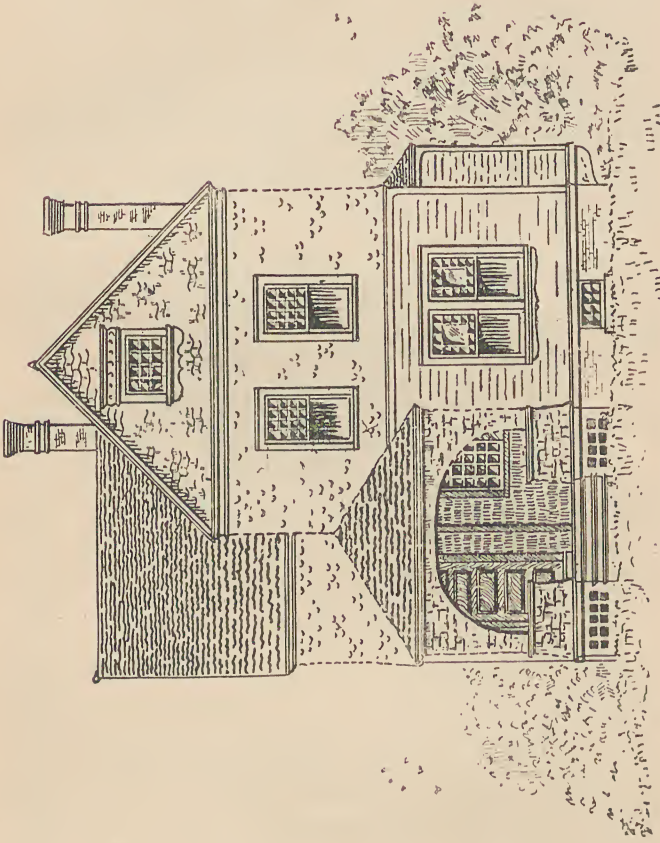


Fig. 27.—FRONT ELEVATION.

DESIGN VI.

SUBURBAN COTTAGE, COSTING $2,500.

As will be seen by the plans, there are seven rooms above the basement, besides the attic. Each bedroom having ample closet space and light. The upper hall will receive light from a window at the head of the attic stairs. The dining-room has a bay-window and open fire-place; the parlor, and large bedroom above the parlor, have open fire-places also. This house is suitable for almost any site, and will be found especially available for a narrow lot. Within the past few years our conception as to what a country dwelling should be, has entirely altered. Simplicity and refinement of design are in demand, and exterior display, over-crowding with scroll-saw ornamentation, is no longer in favor.

Dig out the ground under the building the depth required for the cellar and foundation walls. The cellar wall and chimney foundations are to be built of sound, well burnt brick, laid in mortar made of clean, sharp sand and cement. Select the best brick for topping out the chimneys. Provide blue stone sills for cellar windows and coping for chimneys. The house is to be substantially framed, braced, and plumbed. Sills, posts, girts, and plates to be framed together. Braces framed in, and outside door and window studs framed in at top and bottom. All other studs to be nailed in firmly. All partition studs to be set particularly true and plumb. The floor to be bridged with one by three-inch stuff, cut on the bevel, scribed and well nailed to the joists. Spike the rafters well to the plate. Sheath the entire structure with hemlock boards, and good quality of pine clapboards and shingles, according to the design as shown on the elevation. Flash with best charcoal tin the val-

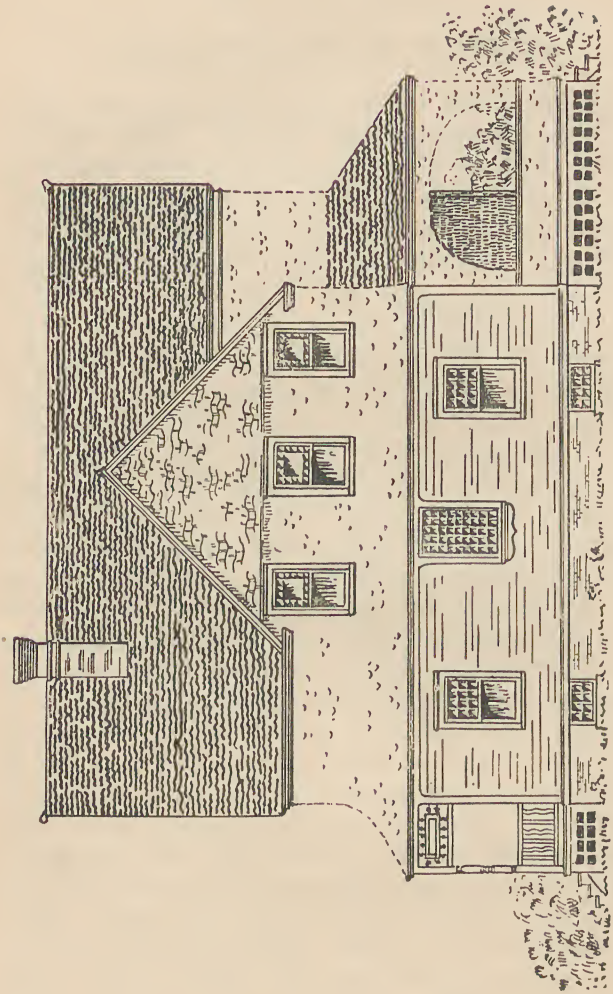


Fig. 23.—SIDE ELEVATION.

leys and chimneys, and cap-flash the ridge. The house is provided with outside door and window casings as shown. Blinds, one and a quarter inch stuff, with suitable fastenings. Floors not to exceed five inches in width, and to

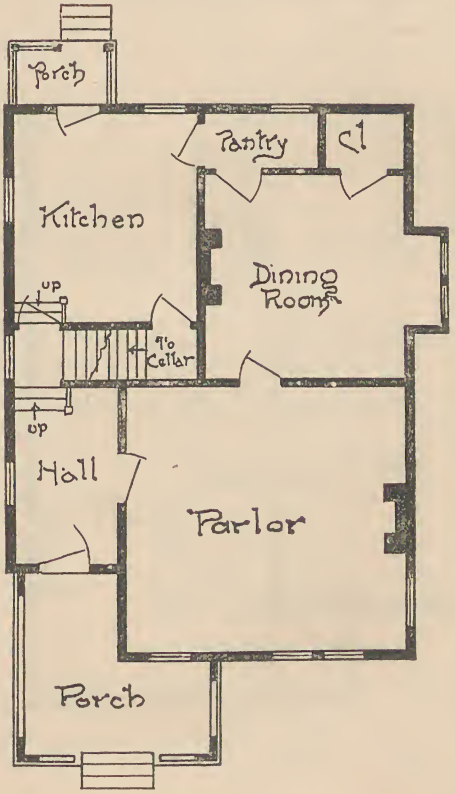


Fig. 29.—PLAN OF FIRST FLOOR.

be seven-eighths inch thick. There are frames and sash complete for all windows, hung with hemp cords, iron weights, and two inch axle pulleys. Proper fastenings for all windows. The doors are made four panels in

hight, and hung with loose-joint butts, and furnished with Kahala bronze knobs. Outside doors as shown in elevation. Provide white pine shelves for all closets. Make the mantels of clear pine, as per design. The shingles used are of the best pine, eighteen inches, laid

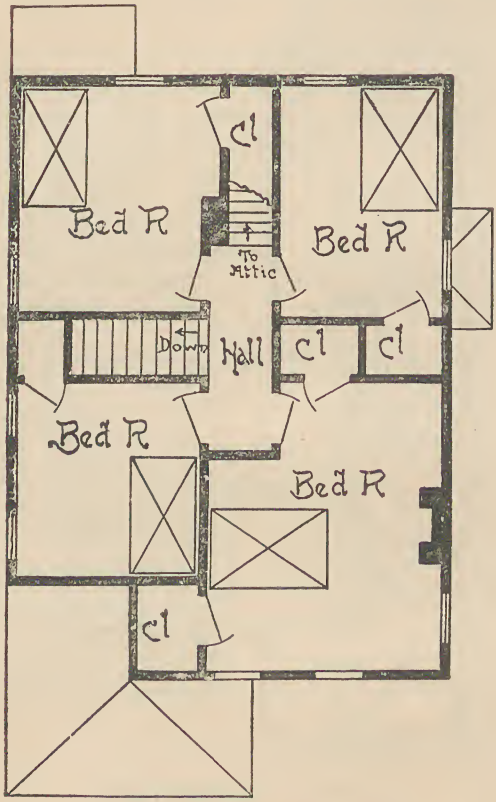


Fig. 30.—PLAN OF SECOND FLOOR.

five inches to the weather, cut as shown. Base boards, six inches by seven-eighths inch, with moulding. Saddles for doors to be of hard wood. All walls, partitions,

and ceilings of all rooms, closets, halls, etc., to be lathed with good, dry, sound lath, laid a full quarter of an inch apart, with four nailings to each lath, joints well broken. Plaster with two coats of brown, well haired mortar, then cover with a coat of white hard-finish. Provide stairs to the cellar, with no risers. The main stair-case to be built as shown by the floor plans, on three stretches of two inch plank, in a substantial manner. Newels, hand-rails and balusters, to be made of ash; the hand-rail closely bolted at its joints. The house here described, can be built in the vicinity of New York, for about two thousand five hundred dollars. Sizes of timbers: sills, four by six inches, halved at corners; posts, four by eight inches; plate, four by six inches; enclosing studs, two by four inches, sixteen inches from centers; partition studs, two by four inches, sixteen inches from centers; rafters, two by six inches, two feet centers; valley rafters, three by six inches; ridge board, one by eight inches; window studs, three by four inches; door studs, two by four inches, doubled; floor beams in first and second story, two by ten inches, sixteen inches from centers; floor beams in attic, two by eight inches, sixteen inches from centers. Whoever travels about the country cannot fail to have noticed the marked improvement in the dwellings in the rural districts, within the past twenty years. Instead of building unsightly boxes, or erecting city houses in country localities, we now find that the new houses are of tasteful and appropriate designs, and suited to their surroundings.

DESIGN VII.

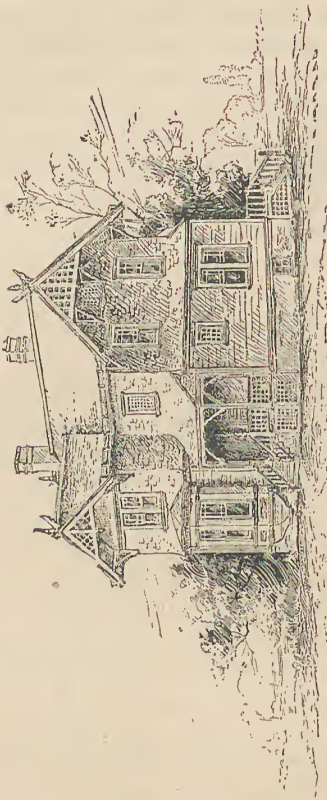


Fig. 31.—PERSPECTIVE VIEW OF MODIFIED SWISS COTTAGE.

MODIFIED SWISS COTTAGE, COSTING $2,600.

The accompanying plan represents a conveniently arranged six-room cottage, which in style may be termed an American adaptation of a Swiss chalet. Its characteristic features are the low-pitched roof, wide projection of cornices, details of open timber-work, finials, dormer win-

dows, and brackets. It differs from the original in the use of slates and shingles for covering the roofs and side walls of the second story, but by a proper selection of colors in painting, the effect is made very pleasing. Although quite in contrast to the so-called Queen Anne

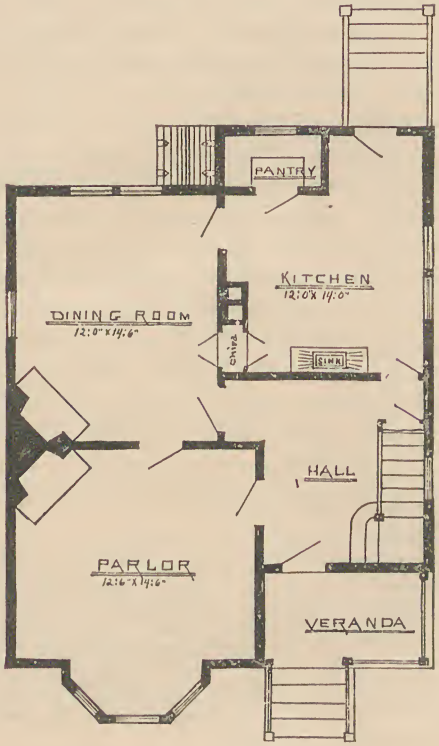


Fig. 32.—PLAN OF FIRST FLOOR.

cottages, we believe that this style is destined to become popular. The first story is nine feet six inches in hight, and the second nine feet, all in the clear. There is a cellar under the kitchen and hall, seven feet deep in the clear, with a concrete floor three inches in thickness, with

outside steps, and inside plank stairs. The footings of foundation walls and chimneys are of large flat stones, bedded in cement, and leveled to receive the brick-work. The foundation walls, piers, and chimney shafts to the roof, are of hard-burned brick. The fire-places, and the chimney-shafts above the roof are of pressed brick, laid in cement mortar, stained red where exposed to view. All flues are built separate, and continuous to the tops of the chimneys. Each chimney has a bluestone cap, four inches in thickness in one piece, with holes cut through the full size of flues. Sheet-iron thimbles with suitable covers, are provided, and properly set in the brick-work where required. Glazed tile hearths, supported on brick trimmer-arches, are laid in the parlor and dining room. Ornamental brass fenders and grates for burning coal, are set in the fire-places. The cellar walls are white-washed, and the ceiling lathed and plastered one coat. The sides and ceilings of all other rooms and closets are hard-finished on two coats of brown mortar, and well-seasoned, sound spruce lath. A soffit, with rule-joint corners, is finished across the opening of the bay window. The frame is of well-seasoned spruce timber of the following sizes :

Sills, 4 by 8 inches.
Posts, 4 by 6 inches.
Plates, 4 by 6 inches.
Girths, 4 by 6 inches.
Floor beams, first and second stories, 3 by 9 inches.
Floor beams in attic, 3 by 8 inches.
Studding, outside walls, 3 by 4 inches.
Studding, doors and windows, 4 by 4 inches.
Studding, inside partitions, 2 by 4 inch.
Girders, in basement, 6 by 8 inches.
Rafters, 3 by 6 inches.
Hip and valley rafters, 3 by 8 inches.
Veranda sills, 3 by 8 inches.
" beams, 2 by 8 inches.
" plates, 3 by 6 inches.
" ceiling beams, 2 by 4 inches.
" rafters, 2 by 6 inches.
Bridging timber, 2 by 2 inches.
Barge boards, 3 by 10 inches.

The floor beams and studding are placed sixteen inches from centers, and the angles of all partitions are firmly anchored together, to prevent the cracking of plaster. Each tier of beams has one row of double cross-bridging, firmly nailed in the center of the widest span. The studding is doubled about doors and windows ; the par-

titions trussed where required. Inside partitions have suitable caps and sills. Cellar windows have stone sills. The sashes are of one and one-half inch white pine, glazed with single-thick American glass. The window frames above the cellar have one and one-eighth inch jambs, two-inch rabbeted sills, and one and one-eighth inch blind-hanging stiles. The sashes in the hall windows are glazed with tinted and hammered cathedral

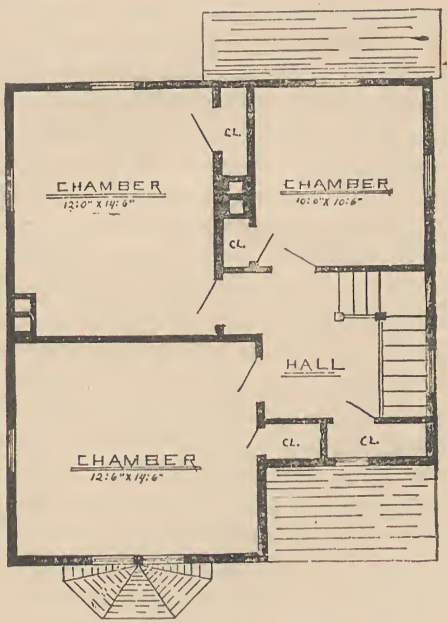


Fig. 33.—PLAN OF SECOND FLOOR.

glass; the attic windows, with single-thick American glass. All other windows are glazed with best quality double-thick American glass. The sashes are of clear white pine, one and one-half inch thick, hung with loose-pine butts, in basement, hall, and attic. Other sash, balance with cast-iron weights, and brown hempen cord.

Sash-locks, butts, and fastenings are of Berlin bronze, except in the cellar and attic, where they are of cast-iron.

The roofs and sides of the building are sheathed with surfaced tongued and grooved spruce or hemlock, then covered with heavy resin-sized builder's felting paper. The walls of the first story are covered with five-inch clear white pine beveled siding, laid four inches to the weather. The second story is shingled with XXX five by eighteen inch shingles, laid five and one-half inches to the weather ; the shingles stained one coat with a mixture of linseed oil and burnt sienna, before laying. The roofs are covered with eight by sixteen black slates of the best quality, and fastened with galvanized iron nails. Gutters, valleys, and leaders are of I. C. charcoal tin ; hips and ridges of dormer, covered with zinc. The water table, belt courses, barge boards, finials, brackets, half timber work, crestings, corner boards, cornices, bay-window, out-riggers and mouldings, veranda posts, steps, lattice work and railings are all of well-seasoned white pine, made in accordance with detail drawings. The veranda, or porch, has a level ceiling of narrow-beaded white pine, blind-nailed to the ceiling beams. The outside floors are of one and one-eighth by two and one-half inch Norway pine, laid close, in white lead paint, and blind-nailed ; stained and finished with two coats of best spar varnish. Kitchen floor and floors of halls are of kiln-dried, one and one-eighth by three-inch yellow pine, tongued and grooved, well driven together, and blind-nailed to each bearing with flooring nails. The attic floors are of seven-eighth by four and one-half inch tongued and grooved spruce, kiln-dried. All other floors are of one and one-eighth by four and one-half inch white pine, tongued and grooved, and blind-nailed to each bearing.

The main stairs are of yellow pine, with square turned ash newels and balusters, and moulded hand-rails. The

stairs to cellar are of plank with plain pine rail, and door at the top. Architraves for the first story are four and one-half inches wide and one and one-eighth inch thick; moulded in the center, with stamped corner, and moulded plinth blocks. Yellow pine is used in the hall and kitchen; white wood stained mahogany color in parlor and dining room. Windows have moulded panel-backs and base eight inches high, with mouldings and fillets.

The kitchen is wainscoted three feet high, with narrow-beaded yellow pine; pantry fitted with four shelves, china closet to have four drawers below a broad shelf, and small paneled doors above, hung and fitted with Berlin bronze-ware and brass locks. The kitchen sink is fitted with a one and one-half inch maple drip-board, with doors underneath in the usual way.

Mantels of wood in parlor and dining room, with picture-tile facings, all finished, stained, varnished, and rubbed down smooth with pumice stone. Outside blinds to all windows of the first and second stories with patent fastenings, arranged to open and shut from the inside. The architraves for the second story are four inches wide, stamped corner, and plain plinth blocks, base seven inches high, with mouldings. Each closet is fitted with one shelf, and one dozen japanned wardrobe hooks.

All doors are five-paneled, and moulded both sides for all except the cellar and closet doors, which are paneled one side only. The outside doors are two inches thick, glazed as shown. All closet doors are one and one-fourth inch in thickness. All other doors are one and one-half inch thick, hung with loose joint, copper-bronzed butts, and Berlin bronze roses, drops, and escutcheons. Bronze knobs and fittings are for the front door, with bronze-faced mortise lock, night bolt and pass-key attachment. All other knobs of black porcelain, with brass-faced mortise locks, and Berlin bronze roses, drops, and escutcheons.

All cup-board catches and fastenings in kitchen and dining room of Berlin bronze. A gong bell with a bell-pull and all the required attachments is put in the front hall. A scuttle hole is built to reach the attic, and is furnished with a neat step-ladder of white pine. The shingles on the side walls of the second story are stained two coats with a mixture of linseed oil and burned sienna. All other outside wood-work is painted in two shades of brown—the body, a medium shade, with trimmings much darker; sash, black. All inside wood-work not painted has one coat of the Bridgeport wood-filler, then stained, varnished, and rubbed smooth; wood-work of second story has two coats of paint. A ceramic sink is provided for the kitchen, and supplied with cold water from water works or cistern, as desired. The waste water passes through a lead pipe, which leads to a vitrified earthen drain, connecting with the street sewer or cess-pool. The loose earth is used in grading about the house. Gas piping is put in ready for attaching fixtures. The following is an estimate of the cost of erecting this cottage in the vicinity of New York; in many localities where labor and materials are cheaper, it can be built for much less.

COST OF MATERIALS AND LABOR.

108 yards excavating, at 30 cents	$ 32.40
Stone footings	20.00
17,000 brick laid, at $16	272.00
586 yards plastering, at 40 cents	234.40
56 feet bluestone, at 30 cents	16.80
6,000 feet framing timber, at $18	108.00
250 studs, 3x4, at 18 cents	45.00
110 " 2x4, at 16 cents	17 60
500 pieces hemlock, tongued and grooved, at 32 cents	160.00
13 squares slating, at $9.00	117.00
14 " shingles, at $4.50	63.00
1,020 feet clapboards, at 5 cents	51.00
1,456 " white pine flooring, at 3 cents	43.68
700 " yellow pine flooring, at 4 cents	28.00
200 " " " wainscoting, at 4 cents	8 00
2,000 " white pine in cornices, at 4 cents	80.00
10 windows complete, at $10	100.00
2 outside doors, at $8	16.00
1,000 feet pine lumber, base, water table, etc., at 3 cents	30.00
2 mantels with grates complete	90.00
12 inside doors, at $6	72.00
[Carried forward	$1,604.88

[Brought forward	1,604.88
200 days carpenters' work, at $3.00	600.00
8 kegs nails, at $3	24.00
Stairs	60.00
Flashing, tin work, etc.	55.00
Extra hardware	20.00
Painting and glazing	150.00
Plumbing and gas fitting	51.00
Incidentals	35.12
	$2,600.00

By carrying up the extension at the rear of the kitchen, two stories in hight, space for a bath-room can be obtained between the hall in the second story and the chamber above the kitchen. This additional convenience, finished in birch or yellow pine, with two coats of best varnish, rubbed smooth with pumice stone and oil, with planished copper bath-tub, Zane's water-closet, and all fixtures and plumbing complete, would cost about four hundred dollars.

DESIGN VIII.

COUNTRY HOUSE COSTING $3,351.

A very roomy house, with plenty of closets, large attic, bath-room, hot and cold water in first and second stories. Every room, even to the attic, has an adjoining chimney which will admit a stove-pipe. The roofs are all shingled; tin would often be preferred, and in many localities be cheaper. The rooms in constant use are all on one floor —quite a necessity when a woman must have the care of and *do* much of the work in a farm house. A bedroom on this floor is essential when one has little children. The house fronts west, the sitting and bedroom being on the south side. The gables are sheathed and battened. Probably no two persons would fancy exactly the same style of finish, forms of brackets, etc. The outside painting is in two colors, the blinds being of still another color.

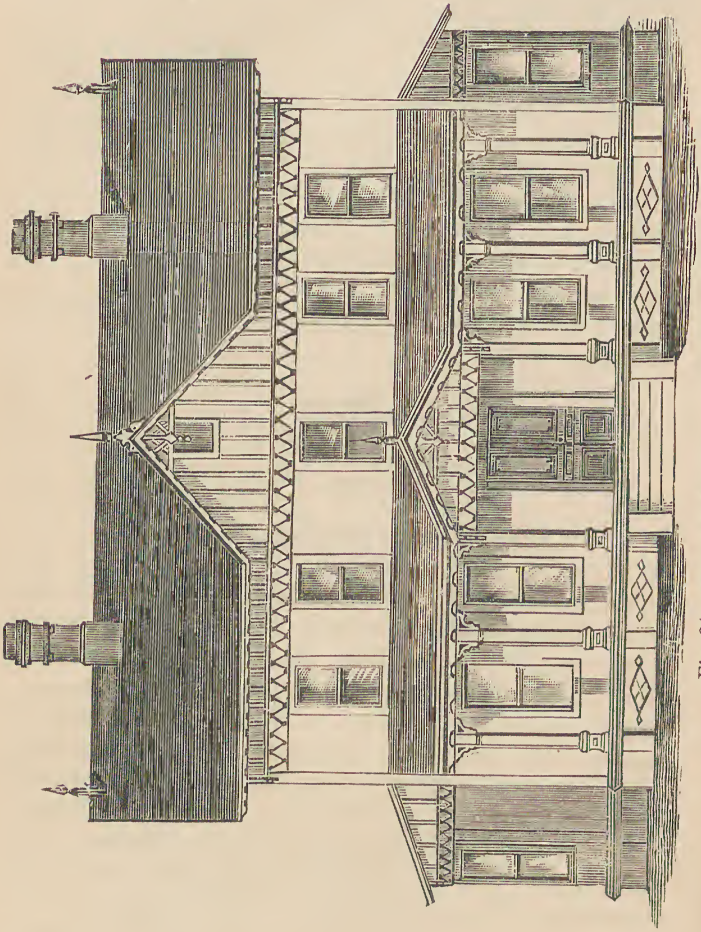


Fig. 34.—FRONT ELEVATION OF COUNTRY HOUSE.

White lead and linseed oil were used, with shading mixtures added for the tinting.

The roofs are all shingled; some may prefer tin over the verandas and bay-windows; the expense is about the same. The frame was first sheathed with boards; then building paper tacked on before the clapboards were put on. The window frames and cap mouldings were made at a factory. All windows have cords and weights. They are "two-light" windows of double French glass. Those on the rear are "four-light" and have single thick glass. The head-light over the front door has stained glass.

The house is finished throughout with hard-wood, and is what is called "polished." All the pores of the wood were filled by hard rubbing with Wheeler's patent filler, a preparation of ground silica found in our markets, then varnished with Crockett's Preservative. These make no change in the natural color of the wood, and is as easy to clean as glass. Few people are aware of the beauty of our native woods, and the farmer who has them growing can finish more cheaply with them than with pine which he would have to buy. With care in sawing, using the outside of the log, and drying carefully under cover, that there may be no stains, a grain of great beauty is obtained. The outside doors are of white oak, two and one-half inches thick, the front one being handsomely made. The others are six-paneled, most of them being two inches thick, some only one and one-half inch. Where the woods are of different kinds in adjoining rooms, the doors are made to match the rooms by gluing together half thicknesses of the two kinds of wood. We used white oak, maple, ash, butternut, chestnut, black birch, and black walnut (the walnut we bought).

The bay-windows and those in the parlor and sitting-room are paneled. The bath room is wainscoted with ash and butternut. The kitchen is also wainscoted. The

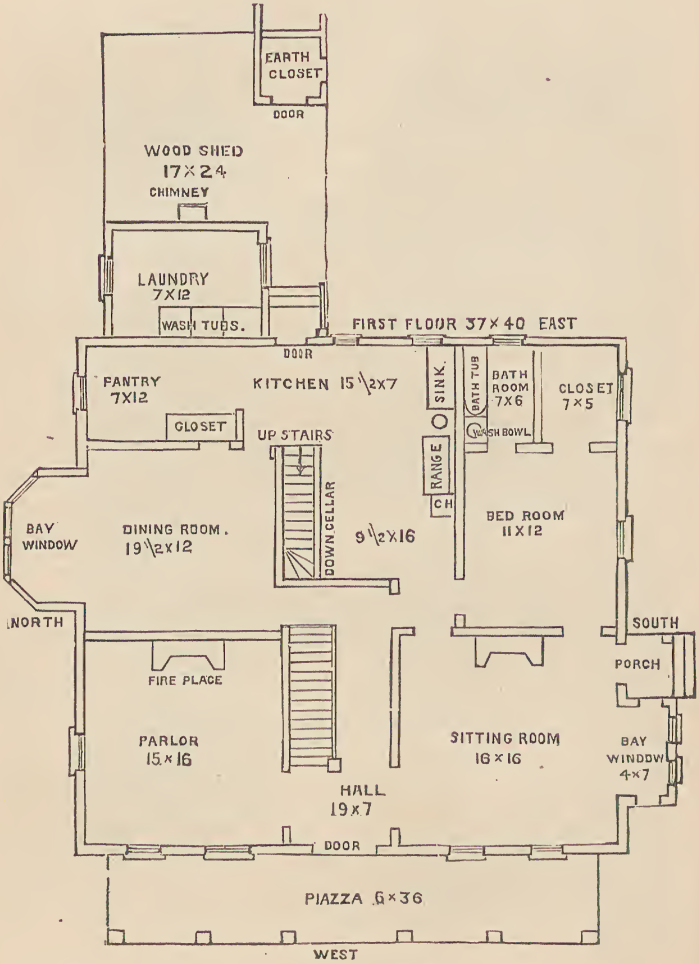


Fig. 35.—FIRST STORY.

kitchen-floor is of three-inch white oak, tongued and grooved and oiled. On the rest of the first story the flooring is of four and one-half inch pine, tongued and grooved. The second story and attic floors are nine-inch white pine, selected from the sheathing boards, which were of extra quality. The shingles are laid on chestnut laths. The plastering on the first and second stories is two coats of brown mortar, with a third hard-finish coat added. The walls and ceilings should be finished before the casings are put on, as any lime getting on the wood before it is polished, will stain it.

The water, for washing purposes only, from the roof enters a tank built in the attic, of pine plank, lined with lead, holding five hundred and twelve gallons. From a cistern just outside the cellar, built of stone and cemented, water is thrown to the tank with a force-pump placed in the cellar, as occasion requires. Our supply has not failed in very dry summers. The water boiler is of galvanized iron, holding fifty-three gallons. The range is a nine-inch Magee, with water-back, for wood or coal—not an "elevated" one. The laundry has three stationary wash-tubs, supplied with hot and cold water. In this room we have taken no precaution against frost, there being only one coat of brown mortar. There are faucets in the cellar, by which we turn the water off as soon as we have finished washing, so there is no danger of freezing. This room also takes much rough work from the kitchen. Directly over the range is a "register," attached to a tin flue running up to the tank-room above. This was put in to keep the tank-room from freezing during severe weather, but it also acts as a ventilator. By pulling down one of the windows from the top in the tank-room, all smoke and steam from the range in cooking is almost instantly carried off through this pipe. We have had no trouble from freezing of the water. The pipes are centrally situated away from outside frost, and all the rooms are com-

fortably warm at all times. The tank-room is eight feet high.

The cellar wall (see basement plan) is of rough stone laid in mortar, two feet thick, eight feet high. The division walls are of concrete, twelve inches thick. The

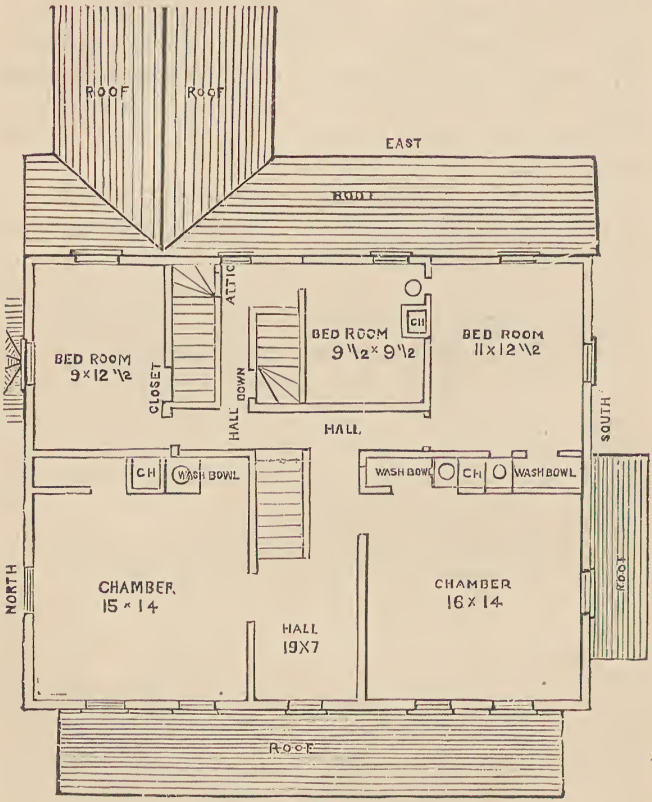


Fig. 36.—SECOND STORY.

cold cellar is shut off from the rest by a division wall, and has a window at the north. The smoke-room is built between the chimney and the brick pier that supports the fire-place above. The back is of concrete, with a door in

front lined with sheet iron. A large flat stone separates the large iron pot holding the smoke-making fire from the part where hams are hung. By means of a loose brick at the top, opening into the chimney, we can adjust the draft at pleasure. There are hooks for twenty hams. The furnace-room was purposely placed in the north-west corner, as from this direction most of our winter winds blow, and you cannot throw much heat from a furnace against the wind. This room is lathed and plastered, and fire-proof. All through as severe a winter as we ever had, the house was heated from cellar to attic so that flowers would flourish in any room, and we could regulate the heat to within four degrees, the twenty-four hours round, week in and out. All farmers know that a large item of expense in burning wood is cutting it into short stove lengths. In this furnace it is burned as it comes from the woods, in four-foot lengths. On damp, rainy days in summer we throw in a little dry stuff, and all chilliness is taken from the air in ten minutes' time. We estimated in the winter of 1880–1, that we burned not more than eight cords of wood. The whole expense of furnace, pipes, and registers, did not exceed $150. In very cold weather, the fire is only replenished twice in twenty-four hours.

The cellar windows are protected outside by iron bars. The cellar steps are of granite got out on the farm, six feet long; all outside steps are of the same material. The front ones are eight feet long, with side pieces nine inches wide, two and one-half feet high, and three feet long. The south one, forming the floor of the porch, is four and one-half by six feet, the steps being six feet long. The rear porches have stones two by four feet, the steps being four feet long. All are cut and faced. The underpinning is two feet high, cut rough face. [Outside cellar entrance is not shown.]

First Story.—Hight of ceiling, ten feet when finished. On this floor we planned to save as many steps as possible. The kitchen is centrally located. The outside door is protected by the projecting roof of the woodshed. There are doors also to most other rooms and to the back stairs and cellar stairs. The sink is supplied with hot and cold water. The pantry is well supplied with drawers and cupboards. The dining room has more length than

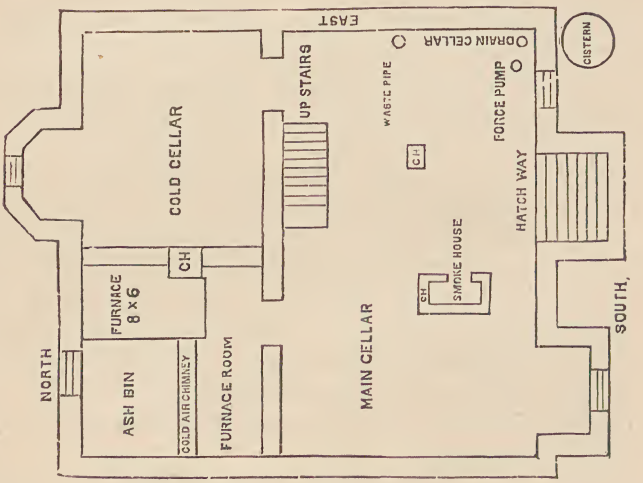


Fig. 37.—BASEMENT (REDUCED SCALE).

breadth, and has a good closet and two cupboards with glass doors [not shown in plan], one each side of the chimney, filling the space made by the parlor mantel. Underneath these cupboards is a hard-wood mantel on brackets [not shown]. A door opens from the dining room into the front hall. The sitting room and parlor have double doors connected by a wide hall, so that these rooms can be thrown together when desired. There is a marbleized slate mantel in the parlor; and in the sitting room a fire-place of hard wood with hard-wood mantel.

The bedroom has a bath-room adjoining, with bath tub and marble wash basin ; also large closet with window. There are speaking tubes running to the servants' rooms above in the attic.

Second Story.—Hight, nine feet. There are five bedrooms, and the front hall can be used as a sleeping-room in an emergency, cutting it off with curtains. A door [not shown] connects the front and back hall. Three rooms are supplied with marble wash basins and hot and cold water. These rooms have also hard-wood mantels set on brackets by chimneys.

The Attic has two sleeping-rooms cheaply finished, also tank-room and dark closet for storing bedding, etc.,

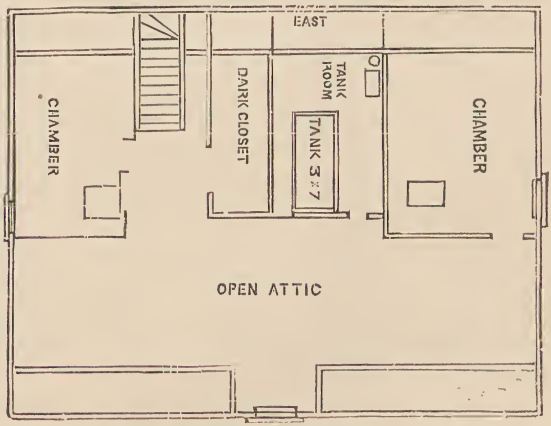


Fig. 38.—attic (reduced scale)....[west.]

with large open attic for play-room, or drying clothes on rainy days.

Construction.—The first-floor timbers are chestnut, hewed one side, the bark taken from the rest, making a foundation as firm as the ground. The rest of the frame is of spruce, bought at a lumber yard. All the wood used in finishing was sawed and planed and cut into proper

lengths at a mill; also all the mouldings struck and the brackets sawed for both outside and inside work. All this is in one bill. All other wood-work was done by carpenters. The cellar was dug and stoned and the steps laid by contract. The steps and underpinning had been procured before. We have included in the expense what they cost at that time. Building the chimneys and plastering were done by two good masons, we doing the tending by farm hands, but this is all included in; also all lime, cement, brick, lathing, and every little thing used. For the timber and lumber used from the farm, in finishing, I have made what my husband says is a large allowance, as the same could now be bought and delivered on the ground for the price named. All bills are given just as they were rendered to us. Probably an advance of twenty per cent. on a considerable portion of the materials and on the labor, would be ample to cover the recent advance in prices. We put down as a liberal allowance $585, which would raise the present total cost to $3,936. This is from a farmer's standpoint. An account was kept at the time of every little expenditure, which is placed under the head to which it belonged. I have given details of many little things, but these make one harmonious whole. We believe in making the farm itself contribute all it can, and I am proud of our stone-work, inside wood-work, and the furnace.

The Wood Shed is seventeen by twenty-four feet, out of which the laundry is taken. The door from the kitchen is protected by its roof, saving a separate piazza. Having the fuel close at hand and dry, is convenient at all seasons. The chimney for the laundry is built mostly of cement pipe. The house stands somewhat higher than the surrounding ground surface. The waste water and that from the cistern overflow is carried off through a pipe in the cellar, into cement drain pipes, closely cemented at joints. I find that my sketch has not placed the front windows

quite as far apart as they really are. In drawing the plans, I have measured everything about the house, and allowed six inches for all partition walls. The veranda posts should be directly at the end of the eight-foot steps. There are no blinds on the south bay-windows, as we intend to add inside ones of hard wood. The "elevation" does not do justice to the house, but it is the best I can do; I find I undertook a pretty big job for a busy housewife.

Cost of Materials and Labor.—Timber, $13 per 1,000 feet. Boards for cornices, trimmings, etc., $24. Sheathing boards (from which the best were selected for upper floors), $16; other flooring, $24. Floor planks, $25. Clapboard siding, $20. Shingles, $4.25. Lath, $1.80. Lime, $1.20 per barrel.

Digging and stoning cellar, laying underpinning, and setting steps	$ 300.00
Plumbing, including all tin work, gutters, valleys, leaders, etc	350.00
General lumber bill	548.66
5,000 feet finishing lumber, at $25	125 00
Timber, and shingling lath	50.00
All hardware, including nails, window weights, etc	123.16
Building paper	8.38
Plastering, building chimneys, bricks, lime, lath, and lathing, etc	350.00
Hand railing and baluster	30.00
Marbleized slate mantel, 4 ceiling center pieces, and brackets	30.00
Making 32 doors at factory	54.35
35 window frames and cap mouldings	59.58
Window sash and glass	100.93
Striking mouldings, sawing and planing lumber, brackets, etc	87.44
4 finials, $3; walnut mouldings, $11.80	14.80
Blinds, delivered unpainted	43.70
Polishing inside wood-work	150.00
Painting (mainly outside), two coats	150.00
Carpenter's bill	525.00
Carting, $100; furnace and fixings, $150	250.00
Total bills paid	$3,351.00
If we add for possible increase of prices	585 00
It would make present cost	$3,936.00

DESIGN IX.

A HOUSE COSTING $3,600.

These drawings represent a modified Queen Anne village residence, designed to meet the requirements of a

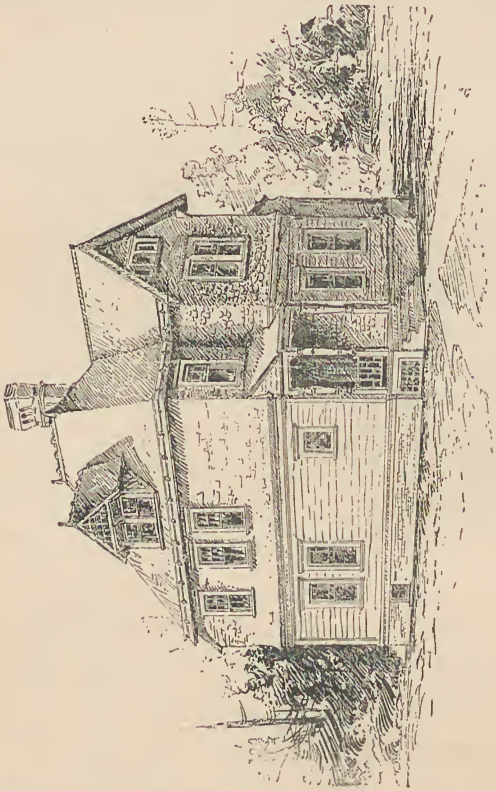


Fig. 39.—PERSPECTIVE VIEW.

family of musical inclinations and cultivated tastes. It contains eleven rooms, namely: parlor, dining-room, music-room, and kitchen on the first story, four bed-rooms

and a bath-room on the second story, and one storage room and one servant's room in the attic, with all the required halls, pantries, and an abundance of closet room.

The rooms of the first story were arranged in strict accordance with the ideas of the owner, who desired that the parlor, which is also used as a sitting-room, should not connect directly with the other rooms. The building is situated upon a rise of ground, occupying a lot fifty by one hundred feet, and commands a delightful view

Fig. 40.—FRONT ELEVATION.

of the sea and surrounding hills. There is a cellar under the entire house, six and one half feet in hight, with outside steps, windows, and the usual plank stairs accessible from the kitchen. The hight of the first story is nine feet, of the second story, eight and one half feet, and of the attic, seven and one half feet in the clear.

The cellar is excavated to a depth of three and one half feet below the grade line, and the loose earth not required in grading removed from the grounds. The footings for the foundation are of large, flat stones, bedded

in cement mortar, and properly leveled. The foundation walls and chimneys are of good, hard-burned brick, laid in cement mortar. The outside of foundation walls below the grade line is thoroughly plastered with Portland cement. The chimneys are brought together in the attic and carried above the roof in one stack. All the flues are built separate and continuous to the top. All exposed brickwork is laid in red mortar, with the joints neatly

Fig. 41.—REAR ELEVATION

pointed and washed with dilute acid, and oiled with two coats of best linseed oil stained with Venetian red. Facings of fire-places are of pressed brick, with glazed tile hearths, supported upon four-inch trimmer arches, leveled with concrete. The outside entrance to cellar has brick walls and blue-stone steps and coping. Cellar door and windows have blue-stone flag sills of usual dimensions, properly built in the brickwork. Iron thimbles and heater pipes were set where directed. The rooms in the attic are plastered one good coat; all closets are plastered in two coats, troweled smooth; all other rooms and the halls

throughout, are hard-finished on two coats brown mortar and seasoned lath.

The frame of the house is of sound, seasoned spruce timber of the following dimensions :

Girders, 6 by 8 inches.
Sills, 4 by 8 inches.
Floor Beams, 2 by 9 inches.
Headers and Trimmers, 4 by 9 inches.
Attic Ceiling Beams, 2 by 6 inches.
Outside Studding, 3 by 4 inches.
Veranda Sills, 4 by 6 inches.
Veranda Plates, 4 by 6 inches.
Bridging, 2 by 2 inches.
Inside Studding, 2 by 4 inches.
Door and Window Studding, 4 by 4 inches.
Rafters, 2 by 6 inches.
Hip and Valley Rafters, 3 by 8 inches.
Plates, 4 by 6 inches.
Veranda Beams, 3 by 6 inches.
Veranda Rafters, 3 by 4 inches.
Veranda Ceiling Beams, 2 by 4 inches.

The beams, studding, and rafters are placed sixteen inches from centers, with a row of double cross-bridging in the middle of the widest span. The angles of all partitions are firmly anchored at their joinings, to prevent the cracking of plaster. The exterior of the building is sheathed with sound, surfaced hemlock, thoroughly nailed to each bearing. The side walls are covered with heavy builder's paper, and the lower story, to the belt course, is covered with clear, white pine beveled siding. The roofs, gables, and side walls of the second story are shingled with best-quality eighteen-inch white pine shingles, laid five inches to the weather. The cellar window frames have one and one-half inch jambs and two-inch plank sills, one and one-half inch sash, glazed with single-thick glass, and hinged at the top. All other window frames have one and one-eighth inch jambs and two inch rabbeted sills, with one and one-eighth blind-hanging stiles, all of white pine. Casement window sash, one and three-fourths inch thick, glazed with single-thick glass and hung with loose pin japanned iron butts, and provided with suitable fastenings. All other sashes are one and one-half inch thick, glazed with double-thick French glass and balanced with cast-iron weights and best hempen cord. Outside blinds to all, except the cellar and attic windows.

The corner boards, gutters, cornices, finials, crestings, veranda posts, railing, outside steps, belt courses and

water table, are all of white pine, as shown on the drawings. The floors throughout are of kiln-dried yellow pine, well driven together and securely nailed to each bearing. Veranda floors laid in paint. The architraves, wainscoting, and skirting boards in the kitchen are of yellow pine. The kitchen sink is wainscoted in the usual way with a cupboard door, the whole finished with one coat of wood-

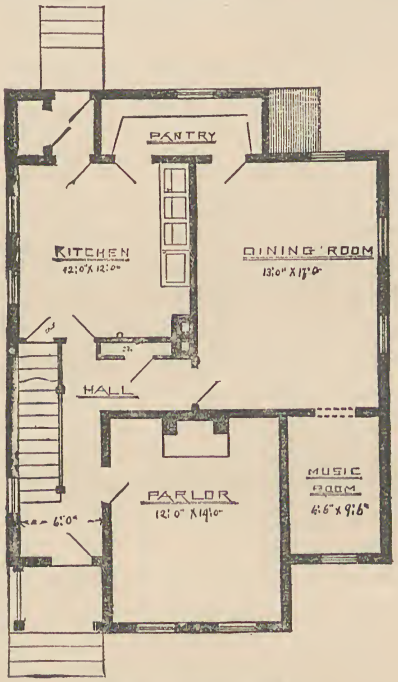


Fig. 42.—FIRST STORY.

filler and two coats of Crockett's preservative. The main stairs are of yellow pine with turned ash newels, moulded rails and balusters, finished with one coat of wood-filler and three coats of Crockett's preservative, rubbed smooth with pumice stone and oil. All other inside woodwork is of clear white pine, stained to imitate mahogany in the

first story, and finished with two coats of Crockett's preservative, rubbed smooth. The woodwork of second story left natural color, finished with two coats of preservative, with the exception of bath-room, which will have three coats.

The woodwork in attic and cellar, and all exterior metal and woodwork, is painted in two coats of white lead and linseed oil. Pantries and closets are provided with shelves

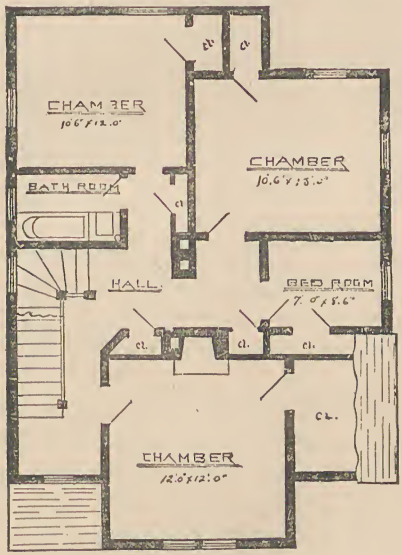


Fig. 43.—SECOND STORY.

and wardrobe hooks in the usual manner. Hardwood saddles to all doors, and rubber-tipped door-stops are placed in the base-boards where required. The front door has raised panels and mouldings both sides, with tinted glass in the upper part. The attic doors are one and one-quarter inch in thickness, with four plain panels. All the other doors are five-paneled and moulded, both faces, one and one-half inch thick for main rooms, and single face,

one and one-quarter inch for closets, all of clear, seasoned white pine. The outside cellar door is strongly built of tongued and grooved white pine. The one and one-quarter inch doors have rim locks; all others have brass-faced mortise locks, with brass bolts, and nickel-plated keys. The front door has bronze knobs, roses, drops and escutcheons, and loose-joint bronze butts. Front door lock has night attachment.

The attic doors have brown mineral knobs, and black japanned roses, drops and escutcheons, and cast-iron butts. All other doors have black porcelain knobs, and imitation bronze furniture, with sash locks to match. The flashings, linings of gutters and all leaders, are of I. C. charcoal tin, painted two coats. A gong bell with all the required attachments, is put in the front hall, with a bell pull to match front door knob. A suitable Raymond furnace, with registers and pipes complete, kitchen range, a forty-gallon galvanized iron boiler, galvanized iron sink, planished copper bath tub, wooden wash trays, and a Zane's sanitary water-closet, with all the necessary cocks, traps, vent pipes, and soil pipes, are properly set and connected, and put in complete working order, ready for use. Two different designs for the dormer window over the hall in the attic, either of which can be used with good effect, are shown in the elevations. The design would be greatly improved for a country dwelling, by the addition of a veranda in front, extending from the end of the music room to the front door. The cost of building the same would be about two hundred dollars.

COST OF MATERIALS AND LABOR.

105 yards excavating, at 30 cents	$ 31.50
21,000 bricks, furnished and laid, at $16	336.00
816 yards plastering, at 35 cents	285.60
60 yards one coat work, at 20 cents	12.00
50 running feet bluestone, at 30 cents	15.00
4,000 feet hemlock sheathing, at $20	80 00
11,000 feet framing timber, at $20	220.00
30 squares of shingles, at $4.50	135.00
1,160 feet white pine beveled siding, at 4½ cents	52.20
[Carried forward	$1,167.30

[Brought forward	1,167.30
1,500 feet yellow pine flooring, at 4½ cents	112.50
2,200 feet white pine finishing lumber, at 5 cents	60.00
3 white pine turned posts, at $4.50	13.50
4 running feet outside railing, at $1	4.00
22 running feet cresting, at 15 cents	3.30
3 white pine finials, at $1	3 00
4 running feet lattice work, at 75 cents	3.00
3 cellar windows complete, at $4	12.00
24 windows with trimmings, complete, at $10	240.00
1 cellar door " " "	5.00
1 front " " " "	10.00
12 room doors " " " at $7	84.00
9 closets " " " at $5.50	49.50
1,600 running feet architraves, at $5	80.00
640 running feet skirting, at 5 cents	32.00
2 wood mantels and grates, complete	60.00
Stairs	72.00
10 kegs nails, at $3	30.00
Extra hardware	10 00
Flashing, tinwork, and leaders	60.00
Painting and glazing	175.00
Range, plumbing, gas fitting, and heating	500.00
Cartage and labor, not included in above	330.90
Builder's profits and incidentals	311.70
Architect's fees	171.30
	$3,600.00

DESIGN X.

A QUEEN ANNE COTTAGE, COSTING $4,697.

The design given in the accompanying engravings, is a good example of a village or country residence in the modern Queen Anne style. It is suitable for a family of means, and in building requires a lot of from fifty to seventy-five feet frontage. The cellar is six feet six inches in hight, and extends under every part of the building except the parlor. The area, foundation walls, and chimneys, are of hard brick laid in cement mortar, and are supported upon footing courses of concrete. The tops of the chimneys and the foundation walls, three feet above the grade line, are laid in red mortar, cleaned with dilute acid, and oiled with two coats of the best linseed oil, colored with Venetian red. The bottom of the cellar is concreted three inches deep, with a mixture of best Rosendale cement and clean, coarse gravel, put down in

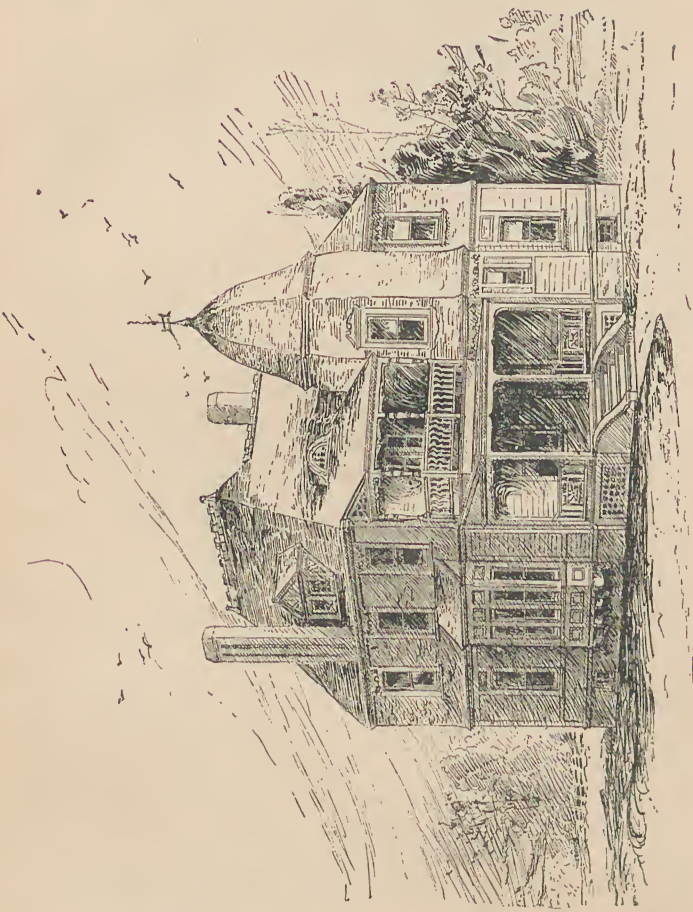


Fig. 44.—PERSPECTIVE VIEW OF QUEEN ANNE COTTAGE.

board moulds well rammed in place, and the top properly leveled. The cellar doorway, window sills, and outside cellar steps, are of blue stone, properly set in the masonry. The first story is ten feet in hight, and contains a kitchen, dining-room, library, parlor, a large hall, and a sufficient number of closets and pantries,

The second story is nine feet six inches in hight, and contains five rooms, each with a closet, and a bath-room. The attic contains two bedrooms of good size, and a store-room. The flues in the chimneys are built separate and continuous to the top, with sheet-iron thimbles set in the brick-work where directed. The rooms in the attic, and all closets, are plastered in two coats; the cellar ceiling is plastered in one coat; all other side walls and ceilings are hard-finished on two coats of brown mortar and seasoned lath. The fire-places in the parlor and dining-room have open grates, and mantels to match the wood-work of these two rooms, and have tile facings, and hearths of selected patterns. The frame of the building is of sound, seasoned spruce, of the following dimensions: girders, six by eight inches; sills, four by eight inches; floor beams, two by ten inches; headers and trimmers, four by ten inches; attic ceiling beams, two by six inches; outside studding, three by four inches; door and window studding, four by four inches; inside studding, two by four inches; rafters, two by six inches; hips and valleys, three by eight inches; plates, four by six inches; veranda sills, four by six inches; veranda plates, four by six inches; veranda rafters, three by five inches; veranda beams, three by six inches; veranda ceiling beams, two by four inches; balcony posts, six by six inches; bridging timber, two by two inches. The studding and floor beams are placed sixteen inches from centers, all strongly bridged. The exterior of the building is sheathed with dry, tongued and grooved, mill-worked spruce, driven well together, and securely nailed to each stud, and cov-

ered with heavy brown manila paper. The side walls of the lower story are covered with dry, clear white pine, and beveled siding. The side walls of the second story are shingled with best quality white pine shingles, and the roofs are slated with good quality black slate, put on with

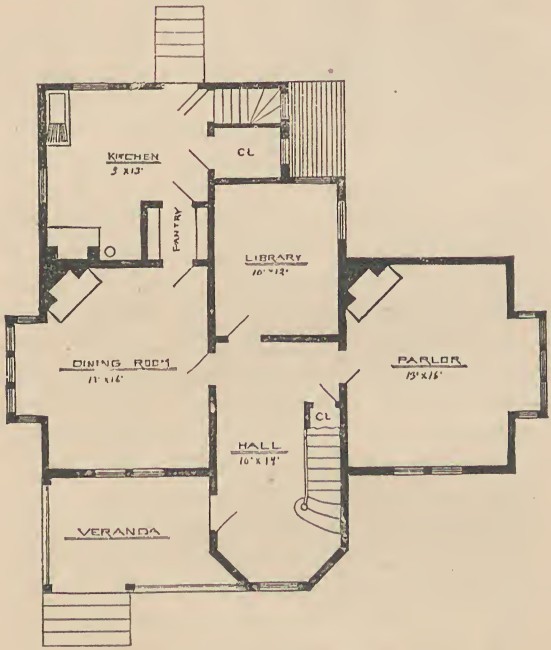


Fig. 45.—PLAN OF FIRST STORY.

galvanized iron nails. The main ridge is surmounted with a terra cotta cresting. The finial on the tower is of galvanized iron.

The cellar window frames are of plank, with casement sash, which are glazed with single-thick glass. All other windows have one and one-eighth inch jambs, and two inch rabbeted sills, with one and one-eighth inch blind hanging stiles, all of dry white pine, free from knots or

blemishes. The sashes are one and one-half inch in thickness, glazed with double-thick French glass, and balanced with cast-iron weights, and brown hempen cord. Outside blinds to all windows except cellar and attic. The front door is veneered with oak, is two inches thick, with five raised panels, moulded both sides. The doors in the attic are one and one-quarter inch thick, with four plain panels. The outside cellar door is built of tongued and grooved white pine, securely nailed to strong cleats with wrought iron clinch nails. All other doors are of white pine, one and one-half inch thick, five-paneled, and moulded both sides. The veranda and balcony posts, outside door and window casings, railings, steps, belt-courses, gutters, corner boards, etc., are of dry, sound white pine, with all the necessary mouldings. The floors of the first and second stories are of kiln-dried yellow pine; veranda and balcony floors are of white pine, laid in paint; attic floor of spruce, all well driven together, and blind-nailed to each bearing. The balcony floor is covered with sheet lead, and made water tight. The architraves and wainscoting in kitchen and pantry are of yellow pine. The architraves, skirting boards and panel backs in dining-room and hall are of oak; in the library of redwood; in the parlor of whitewood, stained to imitate mahogany. The bath-room is fitted in white ash, finished with a coat of wood filler, and two coats of wood preservative, rubbed smooth with pumice stone and oil. All other inside wood-work of white pine, painted three coats as directed. The stairs to the cellar are built of plank in the usual way. Main stairs of oak, with turned newels and balusters, properly filled and polished. The pantry is fitted with shelves, and all closets with wardrobe hooks, as directed. Hard wood saddles are placed under all doors, and rubber-tipped door-stops are attached to the bases. The front dining-room, library and parlor doors, have bronze knobs, butts, roses, drops, and escutcheons, and bronze-faced

mortise locks. The attic doors have brown mineral knobs, and black japanned iron butts, roses, drops, and escutcheons, and ordinary rim locks. All other doors have black porcelain knobs, roses, drops, and escutcheons, black japanned iron butts, and brass-faced mortise locks. Bronze sash locks for the dining-room, hall, and library. Bronzed iron sash locks for other windows. The flashings and linings of gutters, and all leaders are of I. C.

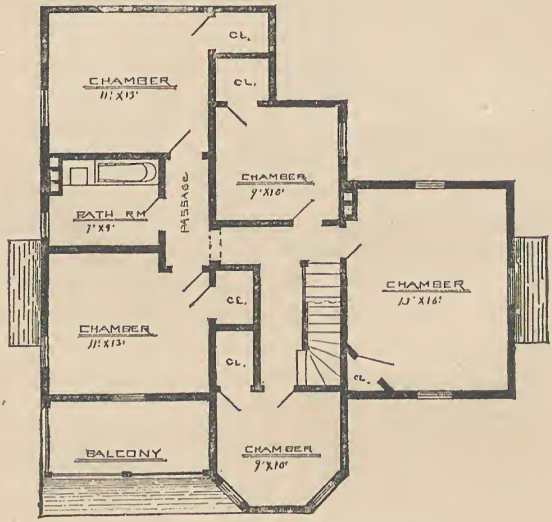


Fig. 46.—PLAN OF SECOND STORY.

charcoal tin, painted three coats, the first coat of metallic paint. A gong bell with all the required attachments, is placed in the front hall. All exterior tin work, iron and wood-work, is painted three coats. Additional requirements are, a furnace, with all the necessary pipes and registers, a kitchen range, with water-back, a forty-gallon copper boiler, a kitchen sink, copper bath tub and a water closet, with all the necessary cocks, pipes, traps, vent pipes, and soil pipes, properly connected and brought

into complete working order. These fixtures may be supplied with water directly from water works, or by means of a tank placed in the attic, which may be filled from the cistern by a force pump.

The small mouldings and narrow projections of the cornices, which are some of the characteristic features of the Queen Anne style, give a building an unsatisfactory appearance without a proper selection and combination of colors, and a proper use of materials. Great care should be exercised in deciding upon the colors to be used. Shades of warm browns are always pleasing, and suggest hospitality and comfort.

COST OF MATERIALS AND LABOR.

130 cubic yards excavation, at 30 cents	$ 39.00
17,000 hard brick, laid, at $16	272.00
900 yards plastering, at 35 cents	315.00
60 yards two coat work, at 25 cents	15.00
44 running feet blue stone, at 32 cents	14.08
180 cubic feet concrete, laid, at 20 cents	36.00
14,000 square feet framing timber, at $20	280.00
6,000 square feet sheathing lumber, at $18	108.00
20 squares of slating, at $10	200.00
2,000 square feet white pine siding, at 3½ cents	70.00
2,500 square feet yellow pine flooring, at 4 cents	100.00
1,200 square feet spruce flooring, at 2 cents	24.00
2,000 square feet white pine finishing lumber, at 5 cents	100.00
600 square feet yellow pine finishing lumber, at 4 cents	24.00
800 square feet oak finishing lumber, at 10 cents	80.00
300 square feet redwood finishing lumber, at 5 cents	15.00
1,000 square feet whitewood finishing lumber, at 4 cents	40.00
400 square feet cherry finishing lumber, at 10 cents	40.00
4 white pine turned balcony posts, at $5	20.00
40 running feet balcony and veranda railing, at $1	40.00
17 running feet lattice work, at 75 cents	12.75
34 running feet tile cresting, at $1	34.00
3 cellar windows, complete, at $4	12.00
32 windows, fitted and hung complete at $10	320.00
1 dormer window, hung complete at $20	20.00
1 dormer window, hung complete at $12	12.00
1 cellar door, hung complete at $5	5.00
1 front door, with trimmings, complete, at $20	20.00
12 inside doors, with trimmings, complete, at $10	120.00
12 closet and attic doors, at $5	60.00
2 wood mantels and grates, set, at $50	100.00
Stairs, complete	160.00
Extra hardware and nails	100.00
Flashing, tin work, and leaders	75.00
Painting and glazing	200.00
Plumbing, range, and heating	600.00
Carpenter work and labor not included above	900.00
Incidentals	174.17
Total	$4,697.00

HOMES AT LEAST COST.

The home-builder is sometimes so situated that he cannot use those materials which the architects and skilled workmen of the world have passed upon, approved, and employed from time immemorial for the construction of human habitations, but he must take that which lies nearest to his hand. For example, the borders of the streams produce cottonwoods and alders, or similar woody growths, and rods or stakes may be cut nearly straight, and seven to ten feet long. Grass is abundant, and by a simple crooked stick, hay or grass rope may be made. If the stakes be driven into the ground, and the hay rope woven in basket fashion, and subsequently plastered with mud, it makes a temporary structure, which, with a thatched roof, partitions of the same material, and well placed doors and windows, may afford the comforts of a home as well as shelter from cold and storms for some years. The mud may be replaced by lime mortar, or cement to such a thickness that, even though the stakes rot off in the ground, as they will, the house will prove a substantial one. Artistic taste may find exercise even in such a structure, and who shall say, hay is not a legitimate building material?

DESIGN XI.

SOD HOUSES OF THE PRAIRIES.

We include in this volume the following hints about the use of prairie sod as a material for the construction of dwellings, as they may be of great value to some pioneer, carrying civilization to far-off wilds.

The first great need of the pioneer settler is a shelter of

some kind for himself and family. This house will depend very much on the amount of money on hand and the distance lumber has to be brought from the railroad. With a few feet of lumber and a little tarred paper one can build a warm and comfortable shanty from the materials to be found on every prairie farm. Sod walls, if rightly made, will keep out cold very well. Select a piece of level ground, with a good turf, and free from gravel and small stones. If the grass is high, it will require mowing. Set the plow so that it will turn a sod about

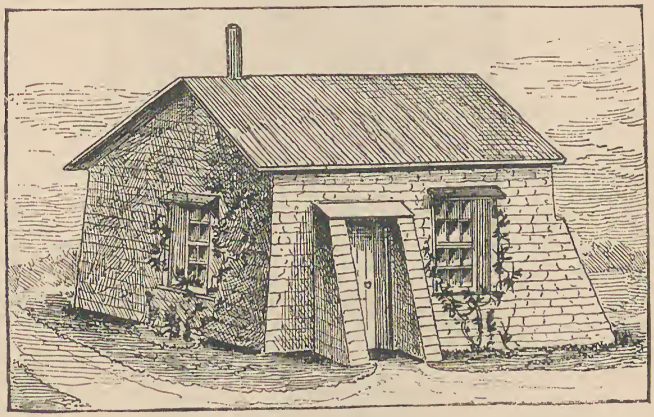


Fig. 47.—A PRAIRIE SOD-HOUSE.

four inches thick, and as wide as the plow will cut out clean. This should of course be done as near where you wish to build as possible. The door and window frames must be all ready before commencing the wall. The door frames should be made of two by eight joist; two pieces cut thirty inches long, and two pieces seventy-six inches long. Nail them together with spikes or twenty-penny nails, setting a short piece at each end between the long ones. This makes a frame thirty inches wide by six feet high inside. On the outside of these joists, sides and top,

nail a strip three or four inches wide on edgewise, about two inches from the outside edge. The window frames may be made of inch boards ten or twelve inches wide, and such a size inside as will nicely fit the sash—the bot-

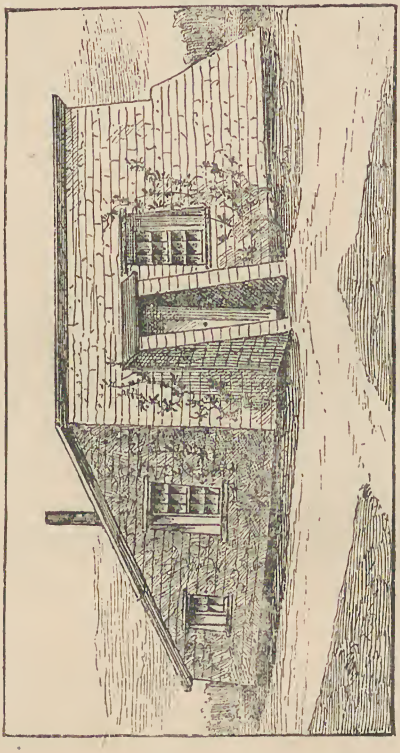


Fig. 48.—A LARGER SOD-HOUSE.

tom board slanting out to shed rain. The frame requires a strip nailed on the top and each side similar to the door frames. In laying the sods, you will need a hatchet with a blade about six inches wide, to cut the sods into lengths; a carpenter's mallet, and an old butcher or case knife.

Mark out the size of the building inside, set the door frames in their places, staying them firmly upright, with

the inside edge flush with the inside wall. Cut the sods into lengths about eighteen to twenty-four inches long. Lay a course lengthwise, as shown in figure 52, fitting the ends closely together by paring them off with the knife when required. Keep the inside edge of this course close to the line of the inside of the building. Outside of this lay two or more courses, depending on the hight of the wall. Four feet wide is none too much for a wall eight feet high, unless the building is to be a very small one. Be careful to fit the courses closely together, and break joints

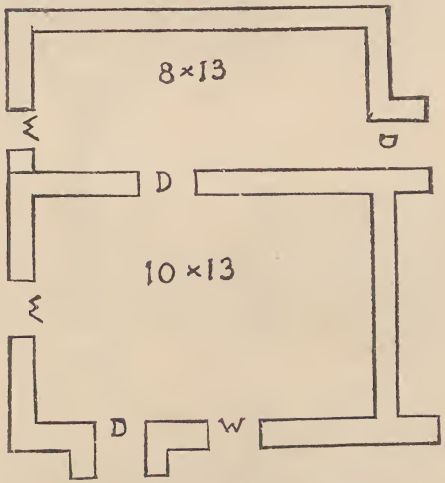


Fig. 49.—GROUND PLAN OF HOUSE.

with each course. Place one layer all around the full width, as shown in figure 50. Buttresses will be found of great service, especially each side of the doors, and may be about thirty inches wide and project four to six feet from the inner wall. Lay the sods grass side up. After a layer is down, fill up any holes or spaces with the pieces trimmed off from the ends. Then with the mallet or the side of the axe go all over the course and level it down, especially on the joints and angles. Fill up and

pound down any hollow or open spaces. Lay three more courses in the same way, breaking joints with the course below, carefully pounding down every course, and filling in with small pieces where necessary. The next course should be laid across the wall, to bind the sods firmly together. If the wall is four feet wide, cut one piece thirty inches long, the other eighteen inches, and lay them as in figure 50. Next lay four courses lengthwise, same as at first, carrying up the abutments with the wall, until within four inches of the bottom of a window. Cut a piece of two by four scantling about a foot longer than the width of the window, and lay it on the wall so it will come

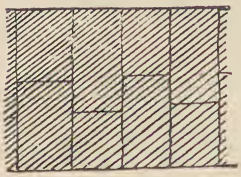


Fig. 50.

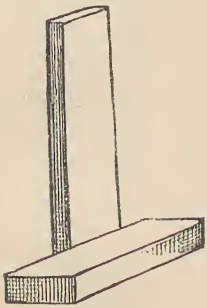


Fig. 51.

about two inches from the outside of the window frame when it is set in its place. If the walls project into the room more than wanted, they may be trimmed off smooth when finished. After laying the scantling as directed, put another layer of sods all around, level with top of scantling. Outside of the scantling, pound the sod down, slanting it towards the outside of the wall, so that an inch board laid on will come level with the top of the scantling and project about three inches over the wall. This will carry off all water that may drive against the window. Set the window frames in their place and nail them to the board and to the two by four pieces. The

frames should then be braced, and the wall carried to the desired hight.

When about two feet from the top, it is well to take some pieces of one by six, about two and a half feet long, and nail them to a piece of two by four scantling a foot long (see figure 51). Set one of these in each corner, as at *A*, in figure 52, also one in each gable end if the house is built like figure 48. If the building is sixteen feet or more long or wide, such pieces may be set in on the walls about four feet apart, then carry up the wall to the hight wanted. Lay a scantling on flat, bringing it up tight to the pieces just built in the wall, and nail them

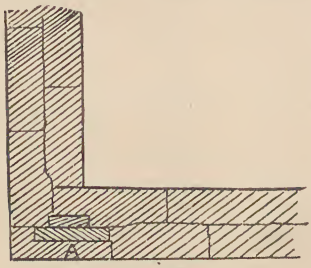


Fig. 52.

solidly together, putting the two by six scantling so that the inside edge will come flush with the inside of the wall. Cut the ends of the sticks off when they project above, and lay on another course of sod, to bring the wall level with the top.

If the house is built as in figures 47 and 48, set in two by six-inch rafters every four feet, setting them up edgewise, and cutting down into the wall with a knife after it is all done. It will be well to build in some pieces of wood, to which the rafters are nailed. The object of these is to fasten the roof down firmly, and prevent the winds from lifting it up and carrying it off, as it might do some stormy night. After the top of the sods is leveled and hammered down, place on the roof, which may be of inch

boards. Nail them firmly to rafters and plates on the side walls, and cover with two thicknesses of tarred paper, running them up and down, and lapping the joints in each layer about three inches. Lay the paper over the ends of the roof boards, which should be cut off true, and

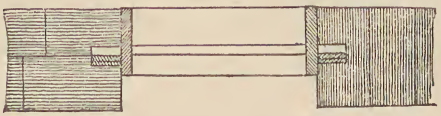


Fig. 53.—SECTION OF WINDOW.

tack on lath or battens eight inches apart, running them up and down. Such a tarred paper roof will shed water for a year without any repairs, if you have been careful not to cut or tear the paper, and if it projects over the sides about a foot, as it should, the sod building will stand for a number of years, and furnish a comfortable shelter for a family.

After the house is all complete, pare off the sods on the outside, so they will look as smooth as a well-laid brick wall, using the hatchet for this purpose. The wall may be drawn in as it is built up, until it is only about half as thick at the top as at the bottom. Pound the outside

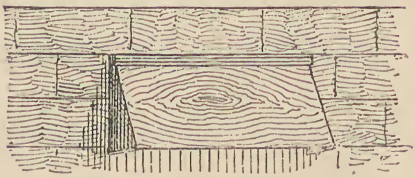


Fig. 54.—A WINDOW CAP.

edges of the sods so that they will slant down and help shed any rain that may strike on them. After the inside is all pared off smooth, nail some four-inch boards up and down, fastening the upper ends into the plates or rafters.

Saw off blocks about a foot long, drive them into the wall about three feet apart, and nail the strips to these. By tacking on common brown building paper and pasting old newspapers over this, the interior is made as neat as if built entirely of wood. Nothing short of a cyclone will have any effect on such a sod house. Many of the points spoken of may seem of small moment, but they all go toward rendering the building wind-proof. Stables and out-buildings may be built in the same way, saving many dollars in lumber that can probably be invested otherwise to good advantage, by many who will make humble homes in the far West.

ADOBES AS A BUILDING MATERIAL.

The early settlers of the Far West, although fresh from the woodland regions of the Mississippi Valley, and the New England States, were not slow in abandoning the log cabin, and adopting instead the sun-baked adobe houses of their Mexican neighbors. The old Mexican adobes are large and clumsy, being twenty-four inches long, twelve inches wide, and six inches thick, and so heavy that both hands of the mason are employed to lift and place them, thus requiring the trowel to be laid down in handling each piece. This was too un-workmanlike for the brick-layers, who demanded a more convenient size, and adopted a dimension which is still in use. A brick-shaped piece of moulded earth or clay, baked in the hot sun, two and one-half inches thick, five inches wide, and ten and one-half inches long, is now the common adobe of this country. There are blue adobes, white saleratus adobes, and common adobes (pronounced "dobys"). Both the white and blue adobes are made from beds of clay found in the lowlands. These clay

beds are more or less impregnated with an alkaline salt. The common adobes are made from any loamy or clayey soil with sufficient adhesive properties to permit the pieces being handled when dried or baked. Formerly adobes were made at the clay beds, thus forming the adobe yards to be found everywhere near the towns and villages. These "doby yards" bear some resemblance to the country brick yards of the Middle States, but lack the debris of the kilns, the kiln-stacks, the piles of fuel, and the sheds of the yards that were made in rainy climates. In some of these adobe yards the common pud-mill of the old-fashioned brick yard is occasionally seen. The adobes made from clay mixed by these mills, are not con-

Fig. 55.—AN ADOBE.

sidered nearly as strong as those made in the more primitive way of treading and mixing the material with the feet.

Adobes are made at the yards as follows: Selecting a place on the bed of clay convenient to water, or where water can be obtained by a small ditch reaching to the nearest irrigating ditch, the top soil is shoveled away where the clay is to be excavated. A space is cleared of the salt grass and rabbit-brush, and leveled for a drying floor. The "doby" maker, with a boy to assist, digs out one or more yards of clay, forms a mound so shaped as to soak up water, throws or runs water upon it, and leaves it to soak over night. In the morning this clay is mixed by treading into rather a stiffer mass than can be worked through a mill.

The "doby" maker then commences to mould by forcibly throwing double-handfuls of the mud into the moulds, which are like brick moulds—bottomless boxes of the right size and hight placed upon a board by which they are lifted—leveling them off with a sweep of the hands, and pushing the mould to the boy, who empties it on the drying floor.

Another mould is filled while the carrier is emptying the first, and so on. An average day's work is five hundred adobes, but from eight hundred to a thousand are frequently made by rapid and skillful workers. After

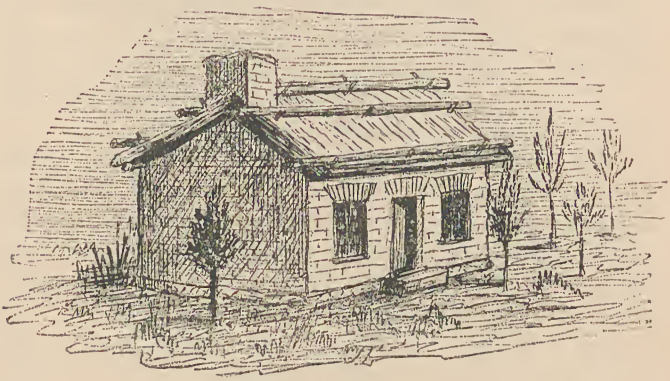


Fig. 56.—AN ADOBE HOUSE.

being partially sun-baked, they are turned up on edge, and when sufficiently dry, are placed in convenient piles. It takes these adobes in dry summer weather, about one week to dry.

The loading, transportation, and unloading of adobes made at the yards, damages a large number by knocking off the corners and edges, and it is hence customary to have them made where the building is to be erected. The clay is piled at a convenient place, and water procured by digging out a small temporary ditch.

Common adobes are always made on the site where they

are to be used, frequently from the earth excavated from the cellar. These are made either by foot or machine, according to the quantity required. They are used either for the inner side of walls or for division walls, where they are not exposed to the weather. In the order of durability, when exposed to the weather, the "white saleratus doby" is all that could be desired.

In examining carefully the wall of a house erected twenty-nine years ago, this variety shows no appreciable wear, while the blue adobes intermixed in the same wall are more or less weather-beaten and worn. This wall has a southern exposure, and has stood the beating rains from the south and west since first erected. In the same dwelling the walls facing east and north show no marks of weather wear, appearing smooth and in as good order as if but recently constructed.

As compared with brick, stone, concrete and frame buildings, those built of adobes (figs. 56—58), have many advantages. They cost less, are as durable, cooler in summer, warmer in winter, and let there be incessant rains for weeks at a time, the walls will never "sweat" or show a particle of dampness.

In Western villages, lack of convenient clay beds has induced the settlers to make adobes of common earth or loamy soil. On western or southern exposures, cottages of such adobes soon look very much battered and worn, the material not possessing power to resist the beating rains.

Adobes require to be well protected by a projecting cornice, and a foundation high enough to keep the drip off of the eaves from splashing up against the walls. When the high foundation is objectionable, the first foot or more above the foundation is frequently constructed of hard brick. Should troughs be fitted to the eaves, the wear on the sides of the walls and the splashing at the base are entirely obviated. When only inferior material

can be obtained for making adobes, they are frequently laid so as to be plastered on the outside, by not filling the outer joints with mortar. Another plan adopted in some localities is to dovetail the edge of each adobe by a piece of wood secured in the moulds. Another still is to drive large nails in the outside walls, about two nails to each adobe, leaving the heads projecting about three-eighths

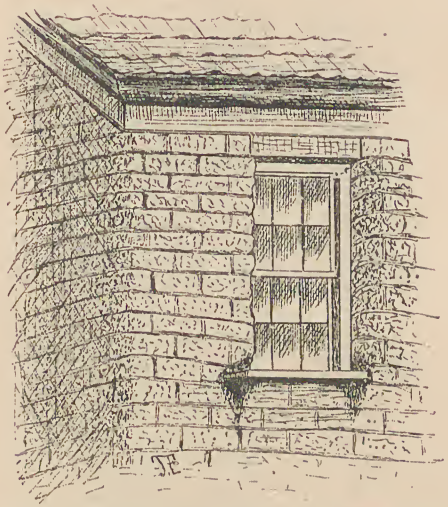


Fig. 57.—ADOBE WALL, THIRTY-NINE YEARS OLD.

of an inch. In either case the plaster is clinched on the walls securely. Adobe walls are laid in clay mortar, composed of two parts of sand, and one part of clay, by measure. This, when dry, adheres so firmly as to make an almost solid wall. As this clay mortar, containing so large a proportion of sand, washes badly when exposed to the weather, it is now the custom to lay the outer tier of adobes with lime mortar, or to point the exposed joints with good-quality lime mortar, which, drying smooth and white in well struck joints, adds much to the beauty of the building. In plastering outside walls, the first two

coats are applied with clay mortar, as lime mortar will not adhere to adobe walls. The last, or finishing coat, is applied with lime mortar, prepared for outside wear. The first and second coats for inside plastering are also of clay mortar, finished with a white coat of either lime or

Fig. 58.—AN ADOBE DWELLING.

plaster of Paris. The mortar adheres firmly enough on inside walls, without any special preparation of the surface. Rarely, an adobe cottage is painted of a brick color, with the joints laid off in white paint. The common blue clay that underlies the sub-soil of many large districts in the prairie States, would no doubt yield excellent

adobes, if made in the dryest part of the summer, and thoroughly sun-baked. As laid in the walls with clay mortar, adobes are capable of supporting great pressure.

A wall in the basement of a large brick building, the second story of which has long been used as a theatre and dancing hall, has supported the pressure of a central post that sustained the center beam of the upper floor, under all the weight and springing of a crowded attendance

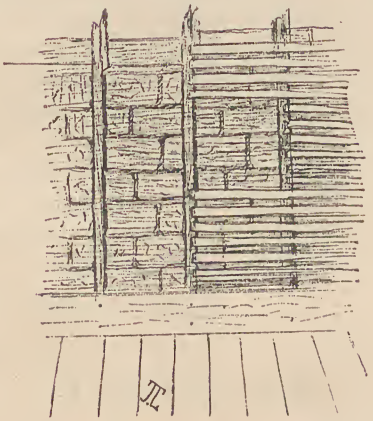


Fig. 59.—ADOBES AS A LINING.

for several years. This wall is only the length of one adobe in thickness—about eleven inches, yet it remains firm.

The church in Payson, Utah, a structure forty-five by seventy-five feet, with walls twenty-four feet high, supporting a heavy roof and belfry, appear as secure as any brick building of the same dimensions. These walls are two feet thick, on a firmly grouted wall which is surmounted with several layers of brick and a stone water-table.

Besides the uses already mentioned, adobes are much in demand for backing the brick walls of dwellings, stores, and public buildings, and are frequently used for the

back walls of stores, being joined to the brick by breaking joints. Three courses of adobes equal in hight four courses of brick. Adobes are also much used as lining for frame houses, being laid up edgeways in clay mortar between the studding. When so used, the laths are placed farther apart than usual (fig. 59). When adobes are used for backing brick walls, it is customary to tie the adobes and bricks together when the courses come even, with light straps of iron laid across every two or three feet.

In the Far West adobes are used for all kinds of buildings, especially on the farm. They could be safely used in nearly all the Mississippi Valley by taking the precautions that have been here mentioned. Many farmers could construct all their smaller out-buildings of this material, and thus add much to the comfort of their animals, and to the pleasure and profit of agricultural pursuits.

DESIGN XII.

CONCRETE HOUSES AND OTHER BUILDINGS.

Concrete is a cheap and good material when one can not get better, and such houses may be really elegant architecturally, for any form which may be given to a brick or stone house, may be produced in this material.

Concrete Frame Houses.—An exceedingly comfortable and picturesque style of house, is one lightly framed with eight to ten-inch wide two-inch planks. Heavier timber may be used if greater picturesqueness is desired —the framing being in this case made conspicuous, braced uniformly, the corner posts being substantial eight by eight, or six by eight-inch timbers. Otherwise, that is when just as little framing is employed as is needed to

support the concrete, while the building is going up and to support the window frames—the plank frame will be found preferable. The corners are made by placing two planks perpendicularly at right angles to each other and touching, or being nailed together at the inner edges, as in figure 60. The dotted lines show the walls. Oak pins may be thrust through the planks, or strong nails may be driven into them, to hold the concrete and the planks together, especially at the corners. Planks thus used, form upright supports for planks inside and outside, between which the concrete for the wall is laid. They are held in place by rods and nuts, the rods running through the wall.

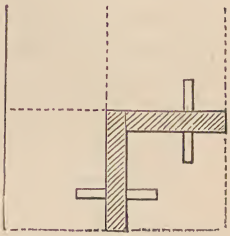


Fig. 60.—THE CORNER.

Another plan similar in principle, but different in architectural effect, is to construct

CONCRETE HOUSES WITH BRICK CORNERS, which may be so built as to be very beautiful. The foundation, and corners, with the fire-places and chimneys, and the surroundings of the window and door frames are all of brick, and the filling in between is of concrete, the brick work being the guide in placing the planks in which the concrete is laid. Twelve inches is a proper thickness for the first story outer walls, and ten inches or a little less for those of the second story.

It is often the most convenient plan to form the concrete into molds, and when it sets firmly in the molds, to remove them and go on with the manufacture of what we may designate as

"CONCRETE BRICKS." These are formed in molds made of boards nailed together, which are almost imperceptibly contracted towards the top, so that when filled with the concrete and set, after an encouraging rap or

two, the mold may be lifted off from the "brick." The width of these should be the thickness of the wall, their hight about a foot, and the length twenty to twenty-four inches. Window caps and sills, simple cornices, and such things, may be molded in the same way, and the work of making the "bricks" may go on at times, when the work on the walls cannot. In making this artificial stone, some pigment may be added, to give the cement, "stones" or "bricks" an agreeable tint. A little lamp black, ochre, and burnt umber, will produce a pleasing effect. The coloring material may be sprinkled in hap-

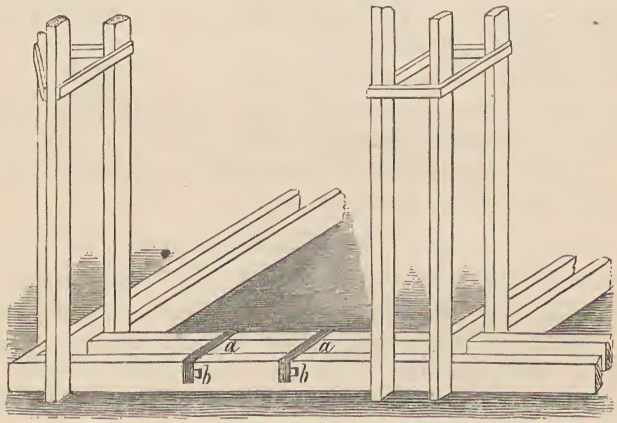


Fig. 61.—THE ARRANGEMENT OF THE POSTS.

hazard, and no pains taken to thoroughly mix them with the cement, nor indeed with one another. Thus, with a little experience, a streaking like the natural *grain*, so-called, of sandstone, may be imitated and the different stones, when laid up, will vary slightly in tint. Great variations or marked streakings should be avoided. The object is to produce a barely perceptible effect, which will break up the monotony and artificial appearance of stones all of one color.

One of the best methods of laying concrete is by means

of planks, to form the mold to hold the mortar—the planks being held in place by posts set at the angles of the wall, and at other points if necessary, and by clamps, both the planks and the clamps being held in place by wedges, all of which is shown in the accompanying engravings. Figure 61 represents the planks in position, and the posts set, held together at their tops by strips nailed upon them, while at the ground they should be held in position by stakes and braces. Figure 62 is a diagram, showing a section or ground plan of the same

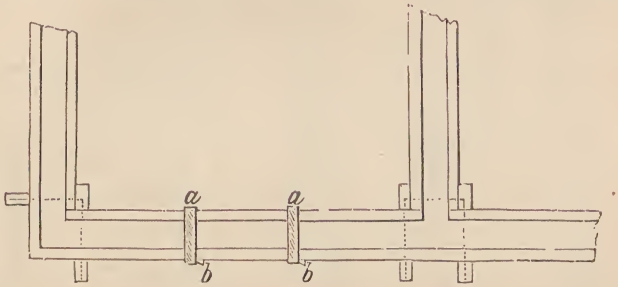


Fig. 62.—ARRANGEMENT OF THE PLANKS.

things; *a*, *b*, are iron clamps, holding the middle of the planks in position in case they are likely to spread apart. Figure 63 is a representation of the walls while in process of erection.

Planks, planed on the side towards the walls, are provided sufficient for the entire circuit of the building, and when in position, the space between them is filled with the mortar. (It is presupposed, that a proper cellar is dug, and cellar walls laid either of stone or concrete). When the mortar sets, which, with a proportion of cement it will do very soon, then the planks are raised and fixed in position by driving wedges between the posts and the wall, as shown in figures 64 and 65—in which *a*, *a*, are the wedges, *b*, *b*, the planks, *c*, a clamp holding the planks together, and wedged on one side, and *d*, *d*, the posts.

The posts will usually need to be braced well to prevent their springing, when the wedges are driven tight enough to support the planks.

Floor joists are laid in places left to receive them, as the walls go up, by setting and tacking blocks of the proper size to the inner planks at the correct level. Afterwards, when that course has hardened, the joists may be

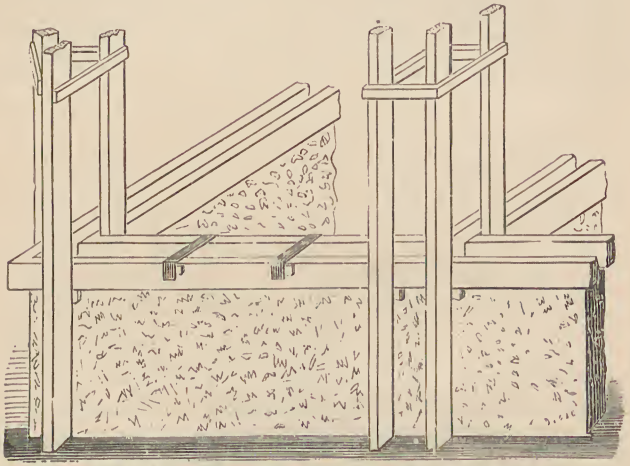
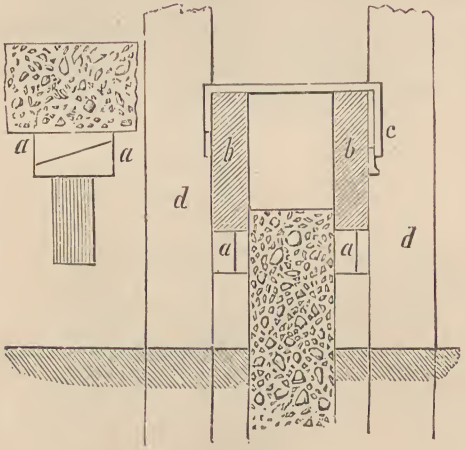


Fig. 63.—METHOD OF LAYING THE CONCRETE.

placed in position. Door and window frames are introduced in their places, and held by braces until the walls rise around them.

MATERIALS USED.—It is best, unless indeed some one in the neighborhood has had experience, to test beforehand the proportions of sand, gravel, and lime, or cement, which are best suited to the proposed work. There is so much difference in the various kinds of lime, that proportions can only be given approximately. A platform of boards will be needed, whereon to mix the materials; one measuring seven by twelve feet will answer, and from it planks are laid in various directions, for going back

and forth with wheel-barrows. Thus, one leads to the house to be erected, another to the lime and cement, one to the sand and to the broken stones, and another to the gravel. When these are brought together, the materials are heaped up in layers of the different constituents. Theoretically, there should be gravel enough to fill the spaces between the broken stones, sand enough to fill the space in the gravel, and the lime and cement should fill in all the chinks and not increase the bulk, but practically we cannot work so accurately, and we use more



Figs. 64 and 65.—RAISING THE PLANKS.

lime and sand than would be required by that rule. Roughly, the proportions may be stated as one part lime to seven parts of other materials, half of which should be clean washed sand. When sufficient materials are accumulated upon the mixing board, they are first mixed dry by repeated shoveling, then the lime, slaked to a creamy consistency, is added, and well mixed through the whole, adding more water if necessary. The addition of one-fourth cement (the lime being reduced to

three-fourths of one part, and the cement being added after the mortar is mixed) makes a much quicker setting and harder concrete. When all cement and no lime is used, but a small quantity can be mixed at a time, for it sets so quickly, that it could not be placed in position before it became solid. The proportions for a smooth, solid concrete are : one part Portland cement to five parts sharp sand. If mixed rather liquid, one-third or more, often nearly or quite two-thirds, of the wall completed, may consist of gravel and coarse broken stones, put in while the cement is being placed in the molds forming the walls. As before intimated, no one should undertake to put up a building without first finding what he can do with the materials at his disposal.

DESIGN XIII.

A SCHOOL-HOUSE, COSTING $4,400.

The accompanying design is suitable for a school-house, to be erected in a village or a thickly populated farming community. It has separate rooms for boys and girls, arranged with large sliding-doors between, so that the rooms may be opened into one, as occasion may require.

The school-rooms are planned to accommodate forty-eight pupils each, seated separately, although a larger number might be accommodated by using double desks and fewer aisles. Separate entrances are provided for each department, with hat and cloak rooms opening from the school-rooms, some provided with shelves and wardrobe hooks. The school-rooms are abundantly lighted with large windows, which extend nearly to the ceiling. A small portable wardrobe is provided for the use of each

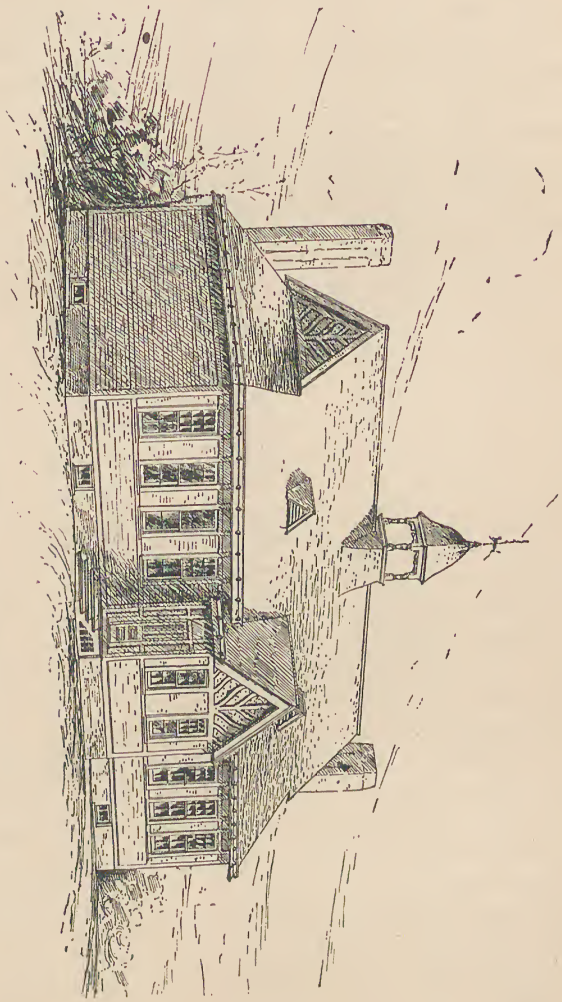


Fig. 66.—PERSPECTIVE VIEW OF SCHOOL-HOUSE.

teacher. A cellar seven feet in hight extends under the building, with a concrete floor, and walls of stone to the top of the ground, and of hard brick two feet eight inches above the ground line; all laid in cement mortar. At the end of each school-room is a brick, ventilating chimney, with a cast iron smoke-flue set in the brickwork with which the furnace flue is connected. The heat from the smoke-pipes produces a draft in the chimneys which carries off the foul air. In places where illuminating gas is available, a lighted gas jet placed inside the ventilating flues, when the furnaces are not in operation, or to accelerate the movement of the foul air at any time, will insure successful ventilation. The warm fresh air is introduced through registers placed in the sides of the building about seven feet above the floor. Suitable blue stone door and window sills, coping, and steps are properly set in the masonry, as required by the drawings. The frame of the building is of dry, sound spruce, of the following sizes: Sills, 6 by 8 inches; plates, 6 by 6 inches; posts, 6 by 6 inches; girders, 8 by 10 inches; floor beams, 3 by 12 inches; rafters, 3 by 6 inches; outside studding, 3 by 6 inches; inside studding, 3 by 4 inches; all framed, braced, and pinned together in a secure manner. The roof is supported by strong king-bolt trusses, placed ten feet apart, all constructed in accordance with detail drawings.

The exterior of the building is sheathed with dry surfaced lumber, covered with heavy sheathing paper. The side walls of the building are clapboarded with six inch white pine beveled siding. The gables of main roof are shingled, and the roofs are slated with best quality black slate, put on with galvanized iron nails. The cornice is made by nailing tongued and grooved boards to the lower projecting ends of rafters, and finished with a neat moulding. The outside steps, corner boards, belt courses, door and window casings, gutter step, half timber work,

barge boards, etc., are of white pine. The school-rooms, entries, and closets, are wainscoted four feet high, with narrow tongued and grooved, beaded yellow pine, with a neat cap and face. Portable blackboards, with chalk-trays at the bottom, are placed on each side of the teacher's desks, arranged so they can be removed at any time for repairs or when it is necessary to open the sliding-doors. The architrave door, and window jambs and casings are of dry yellow pine. The architraves in the school-rooms

Fig. 67.—END ELEVATION OF SCHOOL-HOUSE.

and entries are moulded and have plinth blocks and neatly turned or stamped corner blocks.

The cellar windows have white pine plank jambs and sills, with white pine casement sash, glazed with single-thick glass. All other windows have one and one-eighth inch yellow pine jambs, and two inch rabbeted sills and one and one-eighth inch blind hanging stiles ; clear white pine sash, glazed with double thick French glass. Outside blinds to all except the cellar windows. The belfry is constructed as shown in the drawings, with a tin roof and galvanized iron finial, and is arranged for hanging a

bell, placed in the center of the building so that the rope which rings it may pass down near the teacher's platform in one department. The side walls above the wainscoting are plastered three coats, the last coat to be of soapstone finish, troweled smooth. The angles where the plastering joins the wood ceiling, are finished with a neat moulding. The outside steps are protected by strong batten doors in the usual way. If desired, the wing at the rear can be

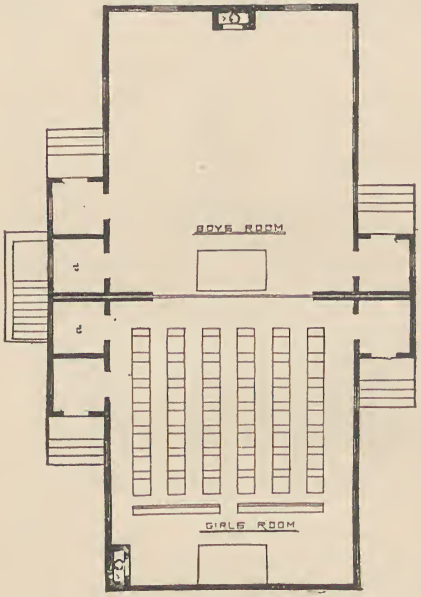


Fig. 68.—FLOOR PLAN.

enlarged so as to build a stairway to the cellar accessible from one of the school-rooms. The school-rooms are heated by means of two portable furnaces supplied with an abundance of pure air. All doors except the sliding-doors are of white pine two inches thick; they are five-paneled and moulded both sides, hung with loose-joint japanned iron butts, and have brass-faced mortise locks,

and black japanned knobs, and furniture. The sliding doors are hung with sliding-door hangers, and have suitable locks and fastenings.

The flashings, linings of valleys, gutters, coverings of hips and ridges, and work in belfry are of I. C. charcoal tin, laid in best manner. The leaders are of galvanized iron, properly connected with a drain or sewer which will effectually dispose of all water. Suitable privies are built for each department entirely separate, with a ventilator to each, the sectional area of which is somewhat larger than the sum of the areas of the holes in the seats, and extended not less than eight feet above the roofs.

COST OF MATERIALS AND LABOR.

337 cubic yards excavating, at 30 cents	$ 101.10
1,760 cubic feet stone walling, at 25 cents	440.00
14,000 hard brick, laid, at $16	224.00
315 square yards plastering, at 35 cents	110.25
372 cubic feet concrete, at 25 cents	93.00
70 running feet blue stone sills and steps, etc., at 32 cents	22.40
64 running feet cast iron smoke pipe	64.00
12,000 square feet framing timber, at 20 cents	240.00
6,000 square feet sheathing boards, at 18 cents	108.00
3,000 square feet yellow pine flooring, at 4 cents	120.00
3,000 square feet yellow pine ceiling, at 4 cents	120 00
3,500 square feet white pine siding, at 5 cents	175.00
1,500 square feet white pine finishing lumber, at 5 cents	75.00
10 doors, complete, at $8	80.00
4 sliding-doors, complete	100.00
35 squares slating, at $10	350.00
1 finial	20.00
2 privies	100.00
Windows, complete	300.00
Sheathing paper	20.00
Flashing, tin work and leaders	75.00
Hardware	50.00
Painting	200.00
Carpenter work and labor	800.00
Heating and ventilating	300.00
Incidentals	112.35
Total	$4,400.10

NOTE.—School-house doors should always open outwards, as a precaution against fire.

DESIGN XIV.

AN EPISCOPALIAN CHURCH.

This church was designed to meet the requirements of a country parish ; but it would be suitable for the suburbs of a city or for a large town. The arrangement was suggested by a clergyman, and is to be commended for its simplicity and convenience.

Two front entrances communicating with a capacious lobby, and the aisles being nearly in a straight line with the outer doors, afford ample space for the entrance and departure of the congregation. The tall bell tower may be seen from a distance, with commanding effect, while the entrances and arrangement of the windows give the building a neat and cosey appearance, so desirable in modern designs. There is a cellar under the entire building which contains the furnaces, coal storage rooms, and water closets, accessible by stairs placed under those leading to the belfry and choir gallery, shut off by suitable doors. If desired, this cellar could be arranged for church parlor and Sunday-school room, by placing the main floor of the church at a greater distance above ground, so as to get sufficient light. On account of the dampness, basements are objectionable, and a better plan would be to build Sunday-school rooms, and church parlor, back of the church, and connect them with the main building. Or, the wing on the side could be enlarged to meet this requirement.

The church is of stone throughout, which is found in the immediate vicinity, laid in irregular courses, with level beds and plumb joints, well bonded and laid in cement mortar. The door and window sills, and lintels, chimney caps, belt courses, water table, cornices, platform, steps, copings, quoins, etc., are of brown stone, medium axed. The voussoirs of the arches, and all the ashler facings, are rock-faced, with proper beds, all pointed with red

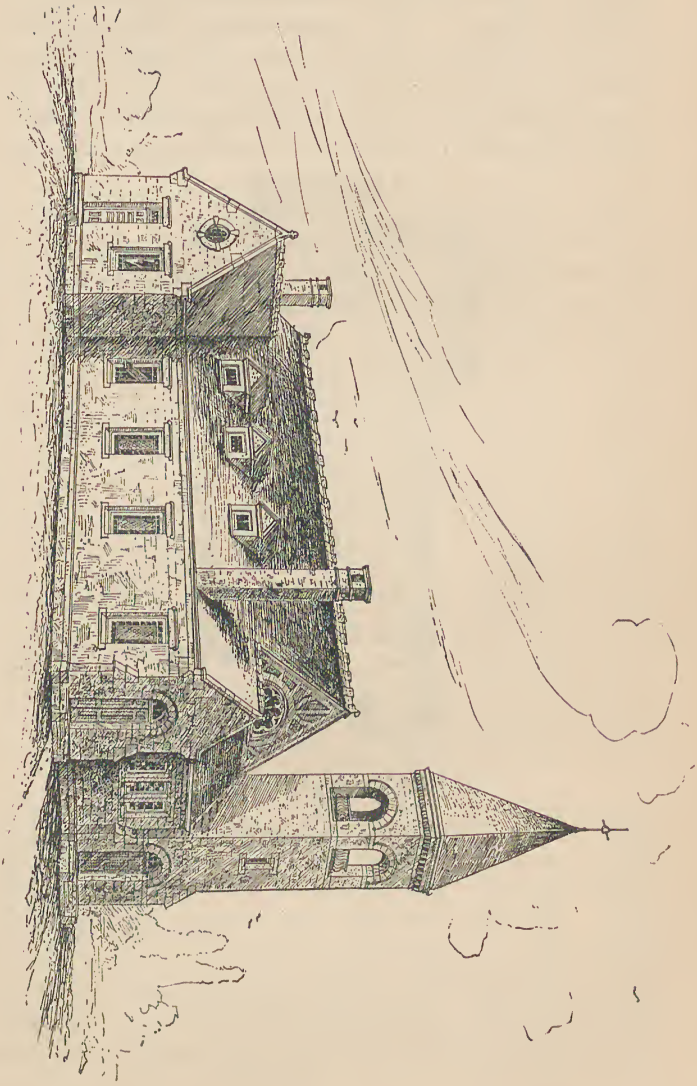


Fig. 69.—PERSPECTIVE VIEW OF EPISCOPALIAN CHURCH.

mortar. The roof is open timbered, and is supported by suitable trusses. With the exception of the furniture, the interior fittings are all of clear white pine, filled and finished in the natural color of the wood. The organ and choir are placed in a gallery in the wing, near the chancel, raised above the main floor of the church about ten feet,

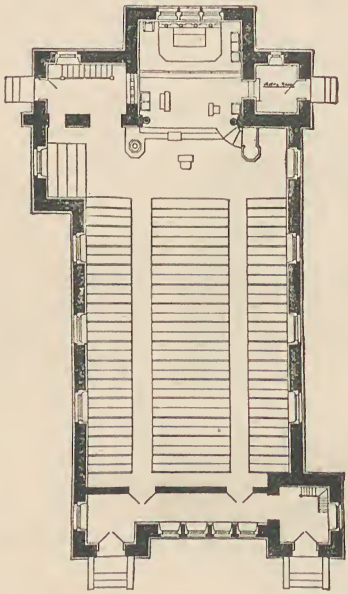


Fig. 70.—GROUND PLAN.

with neatly paneled railing in front, and is reached by means of a stairway from the rear lobby. The walls are wainscoted four feet high, on a level with the window sills. The side walls, from top of wainscoting are plastered with two good coats of best lime, sand, and hair mortar, the last coat a white sand finish, floated to a true and even surface, and tinted a rich buff color. The inside of the dormer windows and main roof is ceiled with clear white pine ceiling boards, and finished with mouldings.

The roofs are sheathed with tongued and grooved dry spruce or hemlock and covered with heavy brown manila sheathing paper, and slated with best quality Pennsylvania black slate. The flashings and linings of valleys are of copper; crestings of terra cotta; leaders of corrugated, galvanized iron. The tower is fitted for hanging a bell, in the usual way. The floor of belfry is covered with sheet lead, and made water-tight. The railings of belfry and finish of tower and rods which brace the chimneys, are of wrought iron. The door and window frames, and sash, are of clear white pine, substantially built and set in the masonry. The sashes are two and one-half inches thick, glazed with hammered Cathedral glass of selected tints and designs, and arranged to swing on pivots. The outside doors are of oak, all others of clear white pine, made in accordance with detail drawings, fitted, hung and provided with suitable locks and furniture. The floors are of yellow pine. A toilet room for ladies, and one for gentlemen, are provided in the basement, each fitted with an enameled hopper, water closet, and a porcelain wash bowl, supplied with water from the street. Proper waste connections with the sewer are made with all the necessary traps, vent pipes, etc. The building is heated by means of two portable Boynton furnaces. All exterior metal and wood-work are painted three coats.

COST OF MATERIALS AND LABOR.

Mason work and materials	$ 8,500.00
Carpenter work, labor, and materials	8,000.00
Plumbing, gas-fitting, and heating	800.00
Hardware and iron work	200.00
Slating and cresting	700.00
Tin work and flashings	180.00
Painting and glazing	1,000.00
Incidentals	620.00
Total	$20,000.00

Built of brick, the cost would be about eighteen thousand dollars. This design can easily be modified to suit the requirements of any denomination, by changing the arrangement of the chancel.

Home Surroundings.

DESIGN XV.

CARRIAGE HOUSE AND STABLE.

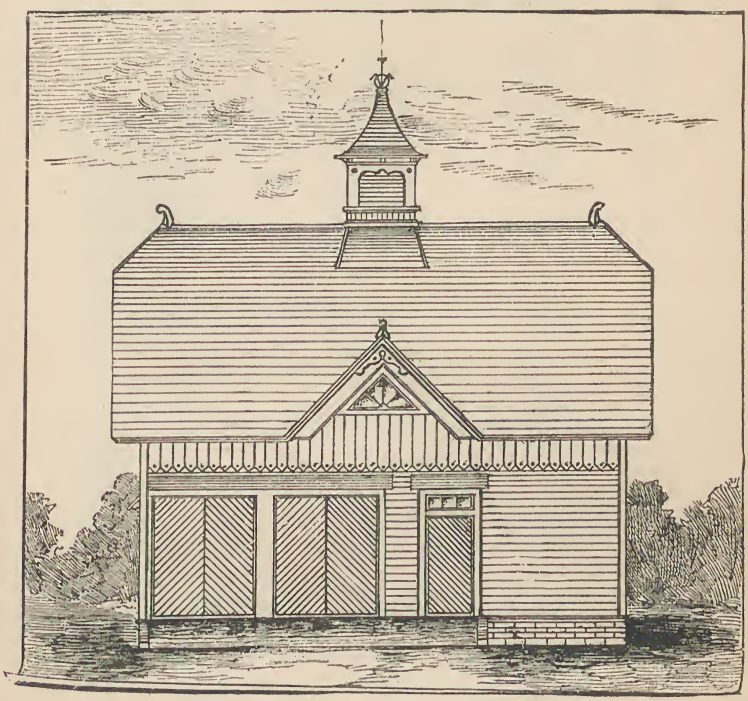


Fig. 71.—SIDE VIEW OF THE CARRIAGE HOUSE.

The carriage house here shown is thirty by forty feet; hight of posts, sixteen feet. The foundation wall starts in a trench below the frost, and is faced and pointed above grade. The carriage room and stable are ten feet high

between timbers. The frame is well braced. The square purline supports the roof. Outside covering, six inch "novelty" siding, except the gables, on which are eight inch boards, battened and finished as shown in the engraving. The doors, made of one by six inch flooring, are covered outside with three-quarter by four inch ceiling

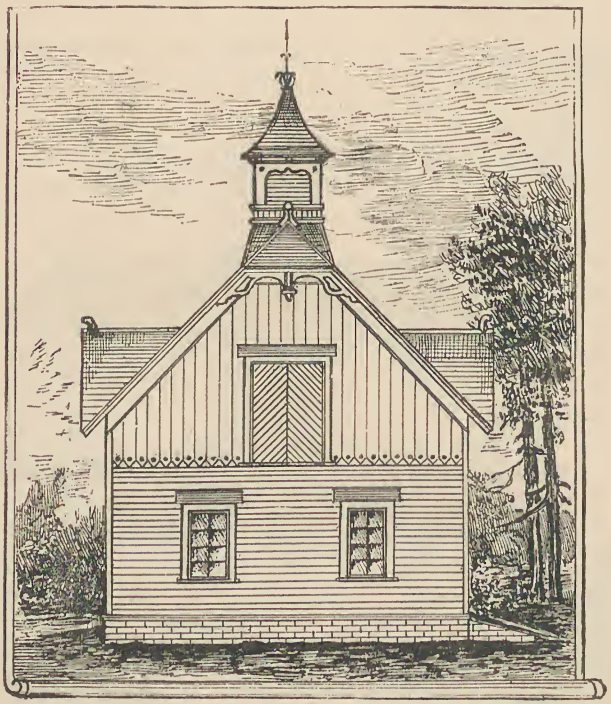


Fig. 72.—END OF THE CARRIAGE HOUSE.

boards, placed on diagonally. Carriage room is floored with two inch plank, dressed and ceiled with one by six inch flooring. Stable floor, two by twelve inch plank, doubled in the stalls, and laid with two inch slope; ceiling, one by six inch floor boards; roof covered with best

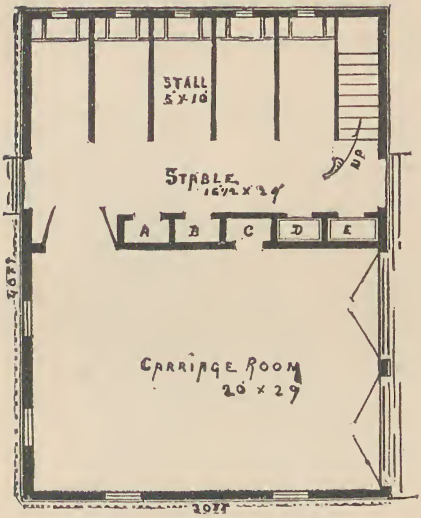


Fig. 73.—INTERIOR OF STABLE.

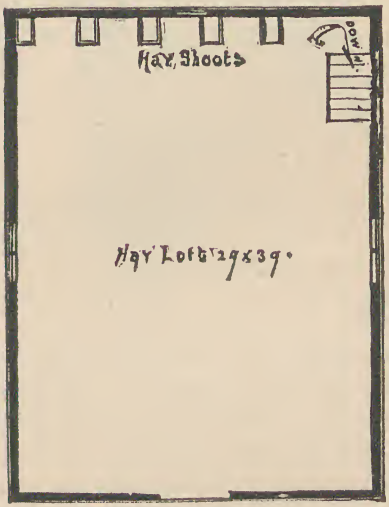


Fig. 74.—THE HAY LOFT.

eighteen inch shingles, on good culled boards, dressed. Cupola, gables, windows, etc., as shown in the illustrations.

COST OF MATERIALS AND LABOR.

2 sills, 8 by 8 inches, 22 feet long.	3 purline beams, 6 by 8 in., 16 ft. long.
4 sills, 8 by 8 inches, 20 feet long.	40 rafters, 2 by 6 inches, 24 feet long.
3 sills, 8 by 8 inches, 30 feet long.	60 joists, 2 by 8 inches, 15 feet long.
6 posts, 8 by 8 inches, 16 feet long.	60 joists, 2 by 10 inches, 20 feet long.
3 beams, 8 by 8 inches, 30 feet long.	60 studs, 2 by 6 inches, 16 feet long.
4 plates, 8 by 8 inches, 22 feet long.	100 pieces, 2 by 4 inches, 12 feet long.
4 purline plates, 6 by 8 inches, 22 ft. long.	75 pieces, 2 by 4 inches, 18 feet long.
6 purline posts, 6 by 8 inches, 14 ft. long.	50 pieces, 4 by 4 inches, 18 feet long.

Total timber, 11,600 feet, at $18	$208.80
2,000 feet roofing, at $12	24.00
15,000 shingles, 18 inches, at $4.50	67.50
2,800 feet novelty siding, at $22	61.60
2,000 feet best common finishing boards, at $30	60.00
500 feet battens, at 8 cents	4.00
5,000 feet 6 inch flooring, at $22	110.00
2,000 feet 2 by 12 inch planks, 12 feet, at $17	34.00
1,000 feet 2 by 12 inch planks, 16 feet, at $17	17.00
8 windows, 8 lights, 12 by 14 glass, at $2.25	18.00
2 windows, 3 lights, 12 by 14 glass, at 75 cents	1.50
5 windows, 1 light, 14 by 16 glass, at 60 cents	3.00
Nails and trimmings	40.00
Eave troughs	15.60
Foundation, $35; painting, $50	85.00
Carpenter work	175.00
Total cost	$925.00

DESIGN XVI.

A SMALL BARN.

A general barn should provide ample store-room for hay, grain, straw, etc.; comfortable quarters for the live stock; convenient storage for wagons and all farm implements; and the best arrangements for making and preserving fertilizers to be returned to the land. The plan herewith presented is for a barn thirty-six by forty feet, with a lean-to shed upon each end. The threshing floor, eleven feet wide, is entered by a sliding door ten feet high, kept in place at the bottom by a hewed sill, placed nearly on the level of the floor and even with the gravel drive-way outside, making an easy entrance for heavy

loads. First, at the right, entered by a door-way three feet wide, is the shop, six by six feet, provided with work-bench, vise, etc., and lighted by two small windows. There is also a window of six, nine-by-fifteen lights, above the entrance, and a similar one at the other end of the

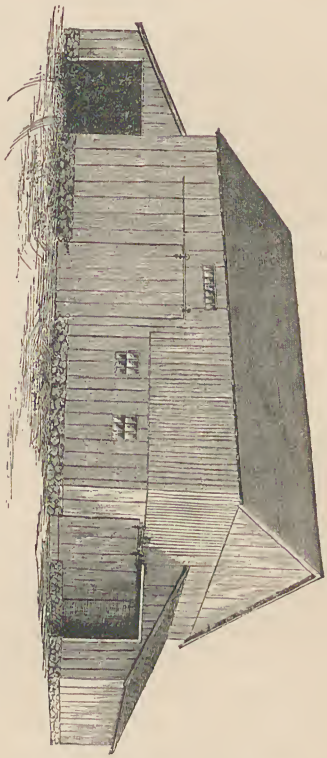


Fig. 75.—EXTERIOR OF A SMALL BARN.

threshing floor above the roof of the shed, which admit all the light needed. Next to the shop is a floorless room, eleven and one-half by sixteen, suitable for a wagon and farm tools; it is entered by a sliding outside door eight feet wide. A stairway, starting two feet back from the line of the threshing floor, leads through a passage

two and one half feet wide, to the floor of the scaffold and granary. The latter, sixteen by eighteen feet, entered by a door three feet wide, is provided with cribs for corn on two sides, two and one-half feet wide and nine feet high, sufficient for four to five hundred bushels of corn. Bins for other grain may be constructed on the other sides as desired. The loft over the granary is reached by a step-ladder (the fruit ladder may be kept there), and is a good place to store lumber, fruit packages, etc. The horse stable, fifteen and one-half by sixteen feet, is divided into three stalls, and has no floor. The slide door opening into the side shed is used in getting in dry earth and other absorbents, while the manure is thrown out at the rear door. A small door next to the stairs is very convenient, and a similar one opening into the rear stall makes a good place to feed a calf when one is kept there. The hay bay has a girt in front two or three feet high, supported by short studs, upon which boarding is fitted tight to the floor, to prevent any escape of grain in that direction while threshing. Similar boarding in front of the cow stable will serve the same purpose and keep the fodder in place. There should be a permanent ladder at the side of the centre post, reaching from the bay girt to the beam. The boarding in front of the stall next to the hay-mow should be hinged, so as to allow a passage-way there when the stall is not occupied. A sliding door at the rear affords a convenient place to supply absorbents, as well as a short passage to the shed. Through a sliding-board window, eighteen by eighteen inches, the manure may be thrown into a shed, where it can be worked over by hogs, when desirable. The mangers should be two and one-half feet wide, and provided with comfortable ties. The rear door of the threshing floor need not be more than eight feet wide and seven and one-half feet high, to slide on rollers like the others. The stable doors opening into the yard might as well have hinges. The cistern, seven or eight

feet in diameter, should be properly protected from the yard, and supplied with a pump and trough. A gate between it and the corner of the barn would allow the passage of a wagon when desired. There may be a floor

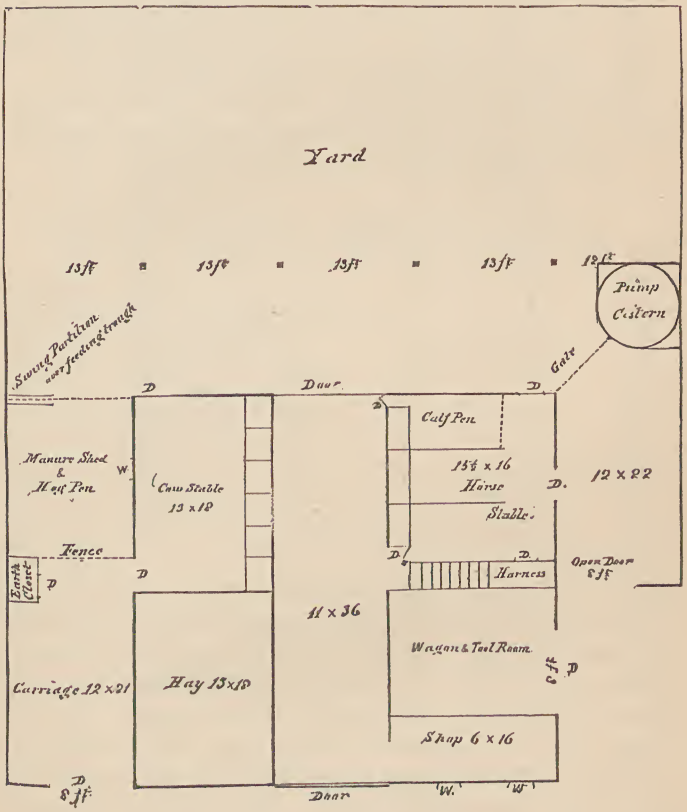


Fig. 76.—MAIN FLOOR OF BARN.

over the rear part of the threshing floor on a level with one in the shed, thus making more room for straw or fodder. The following estimate contemplates boarding the outside with ordinary barn boards, and lining the

cracks with cheap half-inch stuff, two to four inches wide, except the gables, which are without lining and lap over the boarding below the end rafters, being set flush with the same. The crib sides of the granary should be boarded with strips three or four inches wide and an inch apart, being set upon a narrow piece of zinc, nailed over the ends of the lower boards to keep the water out.

In the side of the granary, between the bins and crib, there might be an opening, through which corn could be

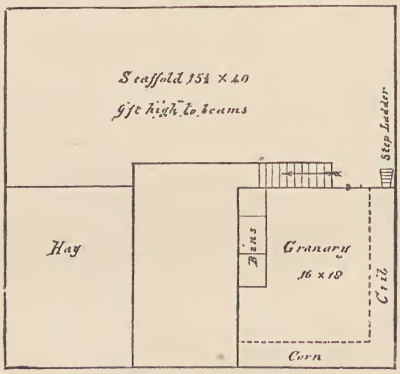


Fig. 77.—LOFT OF BARN.

shoveled from the wagon, and afterwards into the crib. A chute might be constructed, through which grain could be taken directly from the bins to the bags on the wagon in the shed below. The broad boarding upon the side of the wagon-room and granary affords a good place to hang rakes, hoes, shovels, forks, etc., where each can be taken down without disturbing the others, and all be convenient and out of the way. The general appearance of the building might be improved by using dressed boards of uniform width, and covering the cracks with good battens; and further by surmounting the roof with a neat ventilator, and covering with paint. The stables might be paved and cemented at no very great cost.

COST OF MATERIALS AND LABOR.

Sills.

2 40 feet long, 6 by 6, 240 feet.
3 36 feet long, 6 by 6, 324 feet.
1 48 feet long, 6 by 6, 144 feet.
1 30 feet long, 6 by 6, 90 feet.
1 22 feet long, 6 by 6, 66 feet.
3 16 feet long, 6 by 6, 144 feet.
2 11 feet long, 6 by 6, 66 feet.
1 13 feet long, 6 by 6, 39 feet.
3 8 feet long, 6 by 6, 72 feet.
1 6 feet long, 6 by 6, 18 feet.
2 4 feet long, 6 by 6, 36 feet.

Posts.

12 16 feet long, 6 by 6, 576 feet.
7 6½ feet long, 6 by 6, 136 feet.
4 8 feet long, 6 by 6, 96 feet.

Beams.

4 36 feet long, 6 by 6, 432 feet.
4 16 feet long, 6 by 6, 192 feet.
3 18 feet long, 6 by 6, 162 feet.
1 13 feet long, 6 by 6, 39 feet.

Plates.

2 13 feet long, 6 by 6, 78 feet.
2 11 feet long, 6 by 6, 66 feet.
2 16 feet long, 6 by 6, 96 feet.
2 purline, 40 feet long, 3 by 6, 120 feet.
1 shed, 64 feet long, 3 by 6, 96 feet.
1 shed, 48 feet long, 3 by 6, 72 feet.
1 shed, 30 feet long, 3 by 6, 45 feet.

Girts, Braces, etc.

50 pieces 16 feet long, 3 by 4, 800 feet.
6 pieces 13 feet long, 3 by 4, 78 feet.
20 pieces 18 feet long, 3 by 4, 360 feet.

Rafters.

42 24 feet long, 3 by 4, 1,008 feet.
71 14 feet long, 3 by 4, 994 feet.

Joists.

16 12 feet long, 2 by 6, 208 feet.
16 16 feet long, 2 by 6, 256 feet.
12 16 feet long, 3 by 6, 288 feet.
18 12 feet long, 3 by 6, 324 feet.

Total frame stuff, 7,761 feet, at $18	$139.70
Shingle lath, 6,192 feet, at $6	37.15
Boards, 16 feet long, 5,000 feet, at $25	125.00
Yellow pine, 12 feet long, 432 feet, at $25	10.80
Hemlock, 12 feet long, 432 feet, at $18	7.77
Hemlock, 13 feet long, 468 feet, at $18	8.42
Hemlock, 16 feet long, 865 feet, at $18	15.55
Half inch lining, 1,000 feet, at $12	12.00
Cedar shingles, 4 by 24, 18,500, at $9.50	175.75
Stone foundation	45.00
Labor	150.00
Nails	6.05
Rollers and hinges	6.70
Windows	5.00
197 feet eave gutters and tubing, at $10	19.70
Cistern and pump	30.00
Sundries	5.41
Total cost	$860.00

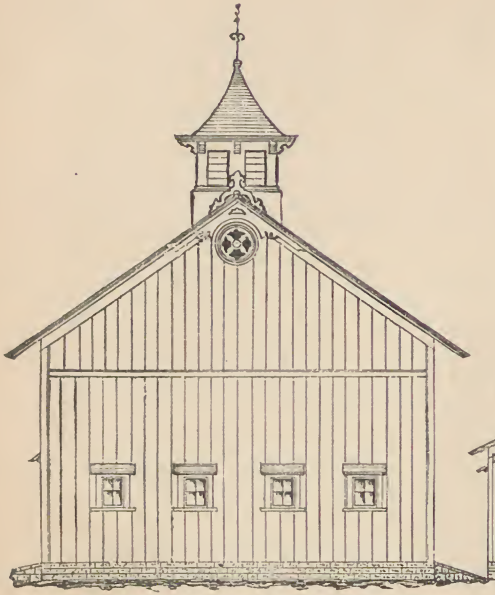


Fig. 78.—FRONT ELEVATION OF BARN.

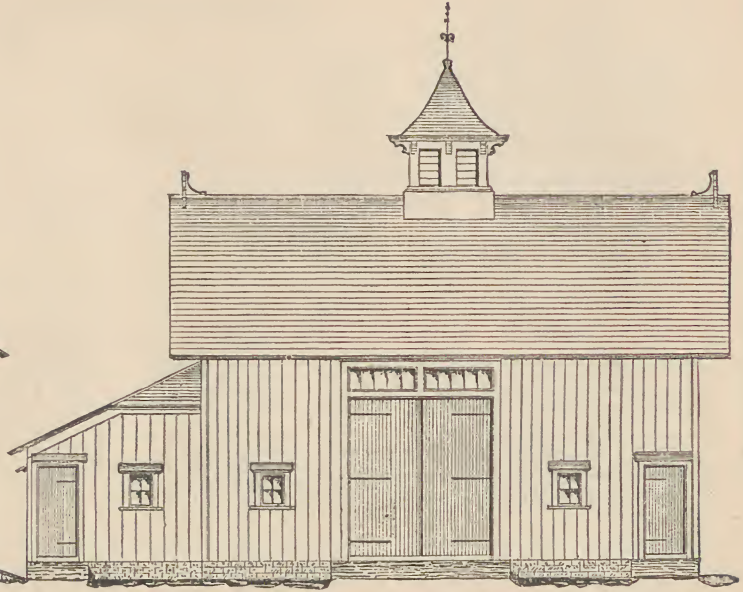


Fig. 79.—SIDE ELEVATION OF BARN.

DESIGN XVII.

PLANS AND DESCRIPTION OF A SMALL BARN.

For general dimensions see drawings, and for timber, etc., see estimates below. The foundation walls are started in a trench below frost and laid in mortar above the grade, eighteen inches high by eighteen inches thick, faced and pointed, with the sills imbedded and suitable openings left in the walls for ventilation. The horse

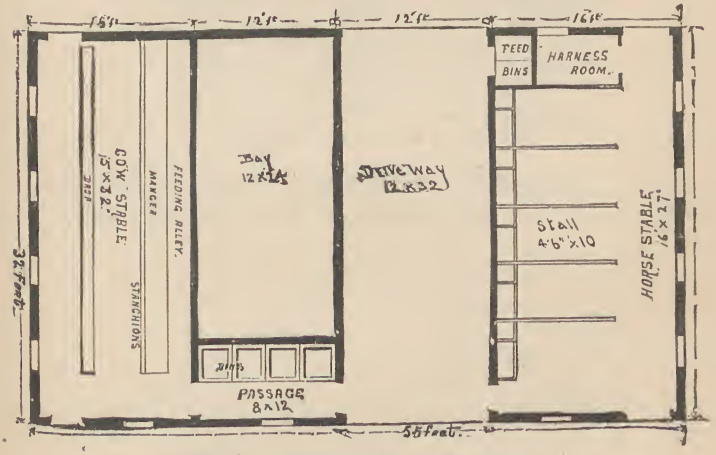


Fig. 80.—GROUND PLAN OF THE BARN.

stable is nine feet high between timbers ; its floor of two inch plank laid with three inch slope, the planks doubled in the stalls. It is fitted up with mangers, feed boxes, harness-room, etc., as shown. The cow stable is eight feet high between timbers ; floor of two inch plank sloping one and one-half inch back to the drop. It is fitted with stanchions, manger, etc., as shown. The driveway floor is of two inch plank dressed and matched, or square edged and lined plank. All the doors are made of one

inch dressed and matched flooring six inches wide. The floors over horse and cow stables are of eight inch matched

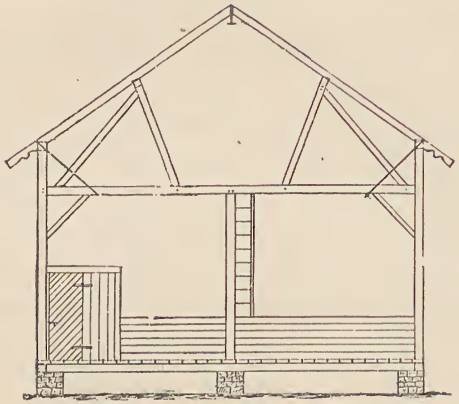


Fig. 81.· BAY SIDE OF DRIVEWAY.

boards. The outside covering of one inch stock boards twelve inches wide, dressed and battened. The cornice

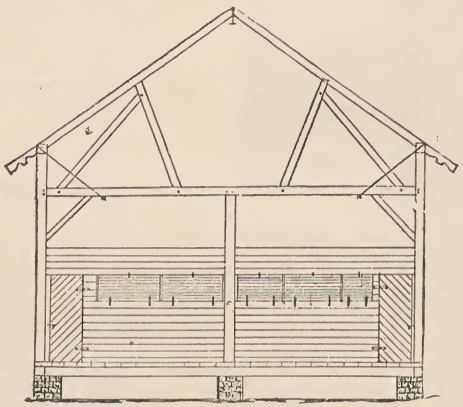


Fig. 82.—STABLE SIDE OF DRIVEWAY.

of the main building projecting about twenty-eight inches, is finished in good style with neat crown moulding. Ends of rafters cut to pattern as shown in section of cow stable.

Outlookers are cut in the same style in the gables. The roof is covered with the best quality of shingles. Cupola as shown on elevations, made thoroughly water-tight around its base. Rafters doubled and made four by six

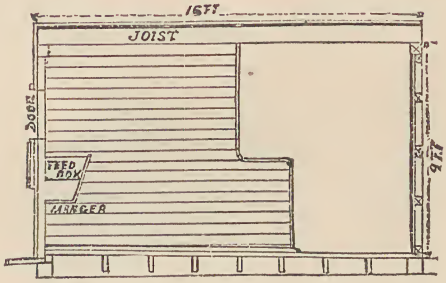


Fig. 83.—SECTION OF HORSE STABLE.

inches under cupola. The tops of the centre bents are secured by iron rods, as shown, in the place of framing. The large doors are hung with three heavy forged strap

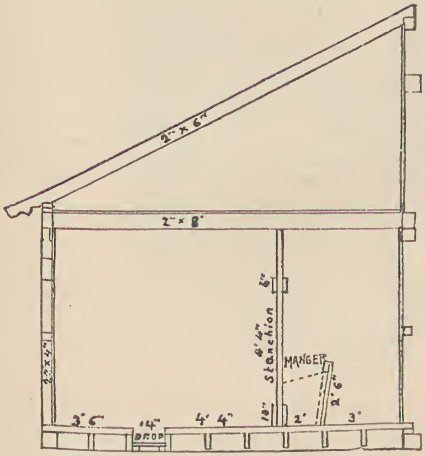


Fig. 84.—SECTION OF COW STABLE.

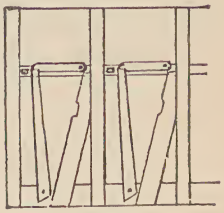


Fig. 85.
THE STANCHIONS.

and hook hinges to each. All other doors are hung with T hinges, and provided with all necessary hooks, hasps,

latches, etc. The outside is painted two coats of iron or other prepared paints, of colors to suit the owner. All material for the small barn to be first-class of its kind, and the entire building to be thoroughly and completely finished, as specified.

COST OF MATERIALS AND LABOR.

8 *by* 8 *inches.*	*Length.*
2 sills. . . To be spliced.	30 feet.
2 sills. . . To be spliced.	28 feet.
5 sills	32 feet.
2 sills	16 feet.
1 sill. . . .13 feet; 1 do.	12 feet.
4 beams	32 feet.
2 plates. . . To be spliced.	26 feet.
2 plates. . . To be spliced.	18 feet.
8 posts. . . .18 feet; 2 do.	16 feet.
7 by 7 inches.	
2 plates. . . To be spliced.	26 feet.
2 plates. . . To be spliced.	18 feet.
8 posts	10 feet.
2 pieces, 6 by 8 inches	16 feet.

6 *by* 6 *inches.*	*Length.*
8 plate braces	12 feet.
6 pieces	16 feet.
4 by 4 inches.	
30 pieces	16 feet.
30 pieces	12 feet.
20 pieces	18 feet.
20 pieces	14 feet.
2 by 8 inches.	
130 joists	16 feet.
20 joists	14 feet.
2 by 6 inches.	
40 rafters	21 feet.
16 rafters	20 feet.
12 pieces	16 feet.
50 pieces, 2 by 4	18 feet.

Total cost of timber, 12,252 feet, at $18	$220.53
2,800 feet roofing, at $12	33.60
19,000 shingles, at $4.50	85.50
2,000 feet 1 by 12 inch stock boards, 18 feet long, at $17	34.00
4,000 feet 1 by 12 inch stock boards, 16 feet long, at $17	68.00
1,500 feet matched flooring, 16 feet long, at $20	30.00
2,200 feet 2 by 12 inch planks, 16 feet long, at $16	35.20
300 feet 2 by 12 inch planks, 10 feet long, at $16	4.80
850 feet 2 by 12 inch planks, 12 feet long, at $18	15.30
2,800 feet battens, at 80 cents per 100	22.40
12 windows, 4 lights each, 12 by 14 glass, at $1.25	15.00
4 windows, 5 lights each, 12 by 14 glass, at $1.25	5.00
Mouldings, $10; foundation, $40	50.00
Carpenter work, $225; painting, $50	275.00
Spikes, nails, bolts, trimmings, etc	50.67
Total cost	$945.00

DESIGN XVIII.

A MEDIUM-SIZED BARN.

The following design is well arranged for the convenience of the general farm of one hundred to two hundred

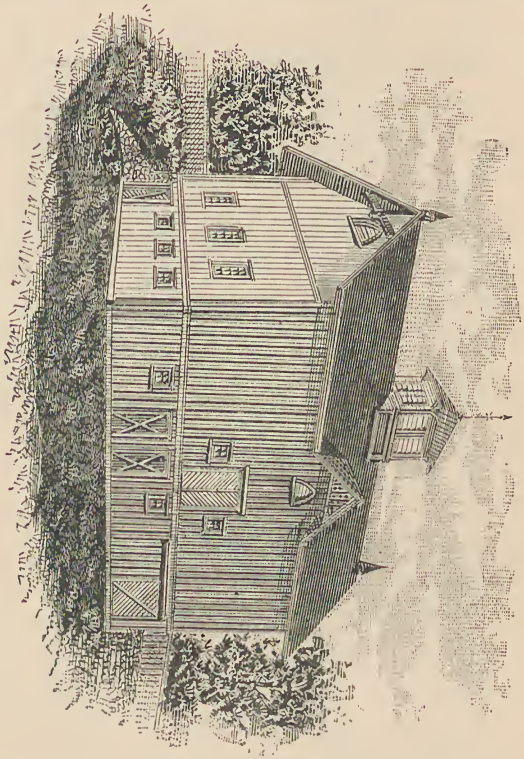


Fig. 86.—REAR PERSPECTIVE VIEW OF THE BARN.

acres. The plans show the general arrangement; the section of frame gives the disposition of middle bents, with a clear opening for the use of hay fork and carrier. The basement is nine feet in the clear; hight of main building posts, twenty feet. The basement timber is oak; the rest,

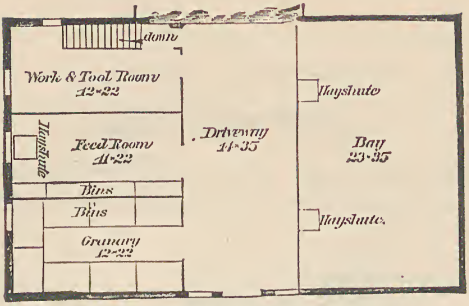


Fig. 87.—PLAN OF MAIN FLOOR.

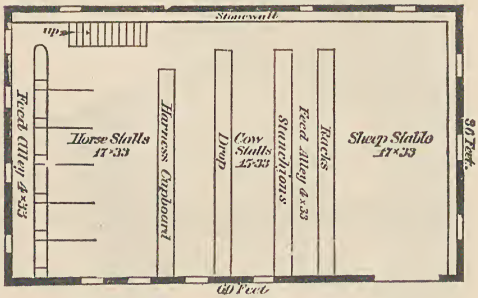


Fig. 88.—PLAN OF THE BASEMENT.

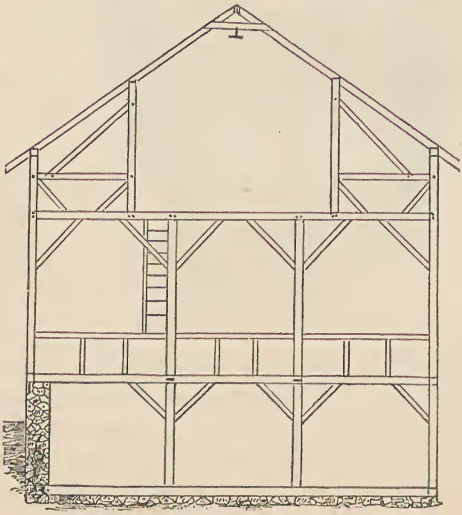


Fig. 89.—SECTION OF FRAME OF BARN.

and covering, is of pine. The cost is about one thousand five hundred dollars. The barn fronts the east, with basement wall extending along the west side and across the north end. The practical farmer will find in building that there are a great many little conveniences that can be worked into a barn of this kind that are difficult to describe, but add much to handiness and ease of doing work.

DESIGN XIX.

HILLSIDE CATTLE BARN.

The barn shown in figs. 90 to 97 is planned especially for a dairy farm, but can be readily adapted to other live stock, by an appropriate arrangement of the divisions on the cattle floor. It is provided for a sidehill situation, of which there are multitudes of good ones in this and other parts of the country. The side view, figure 90, in connection with the other figures, will show its general construction. The main building is fifty feet square, with a covered extension of the upper main floor or bridge, twenty feet to the roadway, which has supporting side walls of stone, dressed or undressed, as may be convenient. This arrangement allows hay and grain to be hauled from the higher ground directly into the main floor at the very top of the building, so that all unloading and moving of the material is downward, until it reaches the manure pit, thus saving lifting. Under the bridge is another driveway, the side next the barn sustained by a stone wall, parallel to and four feet from it, leaving a passage-way for animals into the basement. Figure 91 is an outside or elevation view of the end on the lower side, opposite the main entrance. Figure 92 shows the framing or tim-

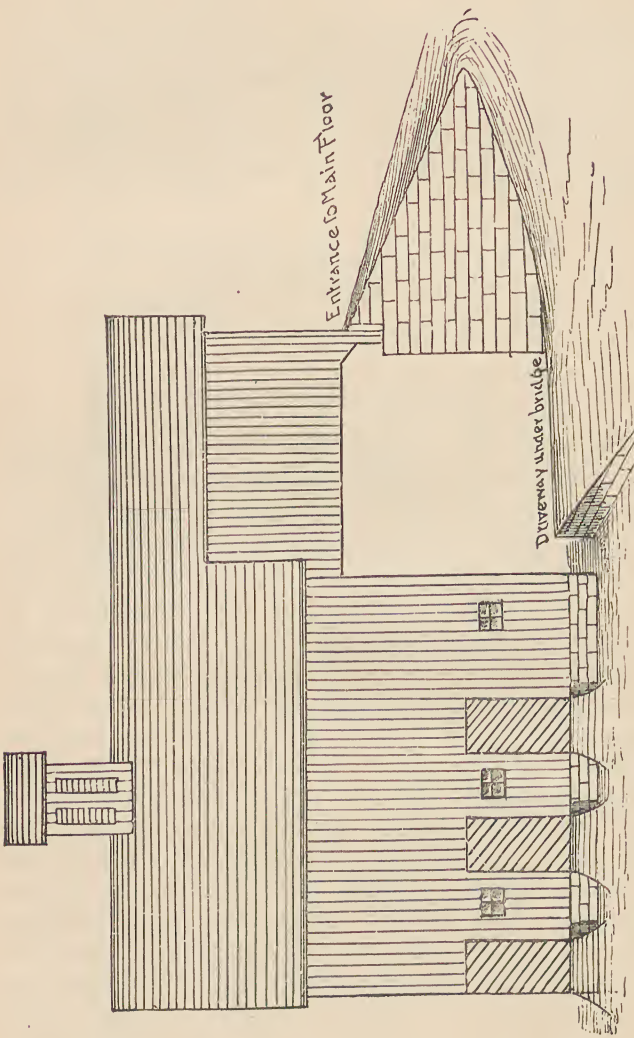


Fig. 90.—SIDE VIEW OF A HILL-SIDE BARN.

bers of that end, and the position of the main drive floor, and other parts. Figure 93 is the main drive floor; *a*, *a*, are chutes, the side of each next the hay being short boards set in loosely as the bays are filled, and removed piece by piece as they are emptied, so that there is no lifting of hay up into the chutes. *B*, a good-width stair to the floor below. Figure 94 is the middle, or granary and feed floor; its position is indicated in figure 92. A platform extends from this floor four feet out to the lower driveway, for

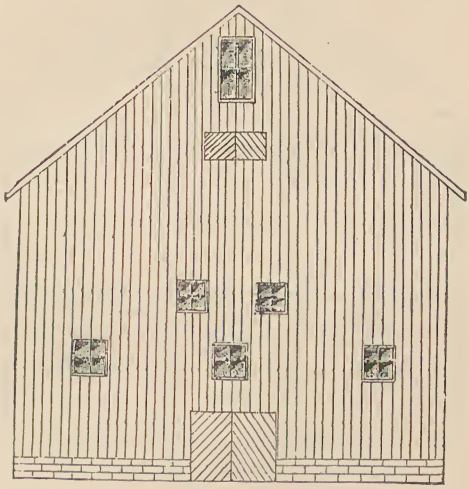


Fig. 91.—LOWER END OF BARN.

oading and unloading grain, bringing in implements, etc., etc. So much of this floor as is needed is devoted to grain and feed bins, and the rest to storing farm machinery, implements, sleds, and sleighs, and may be used for corn, fodder, etc. *A*, *a*, are the continuation downward of the chutes; *b*, stairs and floor above (same as *b*, figure 93); *c*, stairs to floor below; *d*, door to bins; *e*, *e*, *e*, bins, and *f*, passage-way between them. It is convenient to have a spout to bring grain from the threshing-floor

down to these bins, and other spouts to convey ground feed, etc., from the bins to the feeding alley or the cattle floor below. Figure 95 is the cattle floor (marked basement in figure 92), which is arranged for thirty cows, three feet being allowed to each cow, but by utilizing part of the space given to calf pens, etc., the floor may accommodate forty cows, for which there is ample room in the barn to

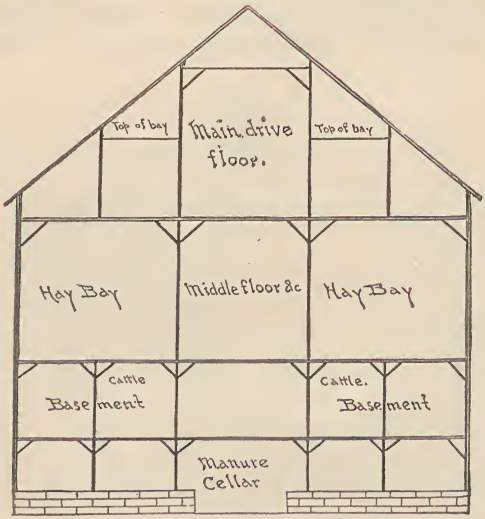


Fig. 92.—FRAMING OF LOWER END.

store sufficient feed, all under one roof, to take them through the severest winter. Hight of ceilings, eight feet. It will be noted that the alley, mangers, etc., of this floor run across the building, the windows, *w, w, w,* in the lower side of the engraving being those of the lower row on figure 91, and the doors on the right side the same as those shown in figure 90. The calf stable is for calves the first winter, and will hold six head. The calf pens are for very young calves. The stall with manger is for a bull. The feeding alley is ten feet wide; it has chutes overhead, through which hay comes down from the mows.

Other spouts, not shown, come from the bins above. The feeding mangers are two feet wide. The platforms are four and one-half feet for medium-sized cows, and two inches wider for larger ones; it is well to have this width vary and place the larger cows on the wider portions. The gutters are eighteen inches wide, four inches deep at the ends and in the center, and six inches at the drain-

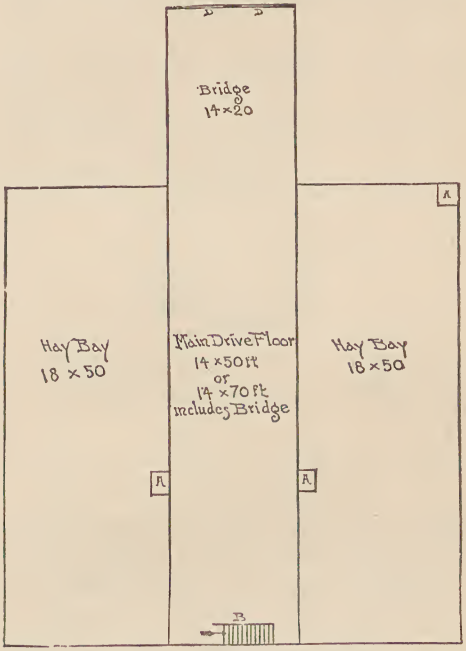


Fig. 93.—THE MAIN DRIVE FLOOR.

age holes, giving an incline to carry off the urine. The manure is passed to the cellar through *m*, *m*, *m*, *m* (to *m*, *m*, *m*, figure 95). The walks behind the cows are four feet wide. The small *x*'s show the places of the posts, which it will be noticed are planned to be out of the way, those in the stalls passing between the cows. Gates *g*, *g*, *g*,

down to these bins, and other spouts to convey ground feed, etc., from the bins to the feeding alley or the cattle floor below. Figure 95 is the cattle floor (marked basement in figure 92), which is arranged for thirty cows, three feet being allowed to each cow, but by utilizing part of the space given to calf pens, etc., the floor may accommodate forty cows, for which there is ample room in the barn to

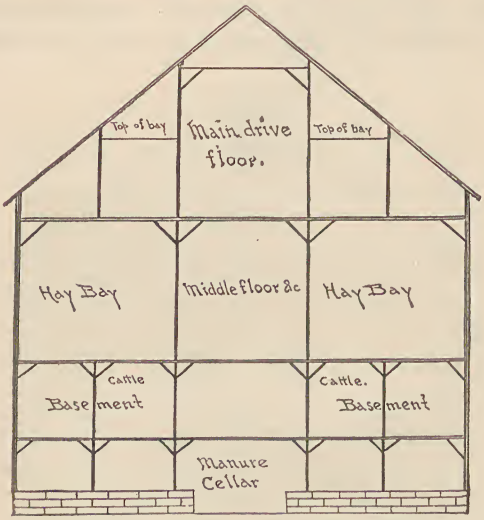


Fig. 92.—FRAMING OF LOWER END.

store sufficient feed, all under one roof, to take them through the severest winter. Hight of ceilings, eight feet. It will be noted that the alley, mangers, etc., of this floor run across the building, the windows, *w*, *w*, *w*, in the lower side of the engraving being those of the lower row on figure 91, and the doors on the right side the same as those shown in figure 90. The calf stable is for calves the first winter, and will hold six head. The calf pens are for very young calves. The stall with manger is for a bull. The feeding alley is ten feet wide; it has chutes overhead, through which hay comes down from the mows.

Other spouts, not shown, come from the bins above. The feeding mangers are two feet wide. The platforms are four and one-half feet for medium-sized cows, and two inches wider for larger ones; it is well to have this width vary and place the larger cows on the wider portions. The gutters are eighteen inches wide, four inches deep at the ends and in the center, and six inches at the drain-

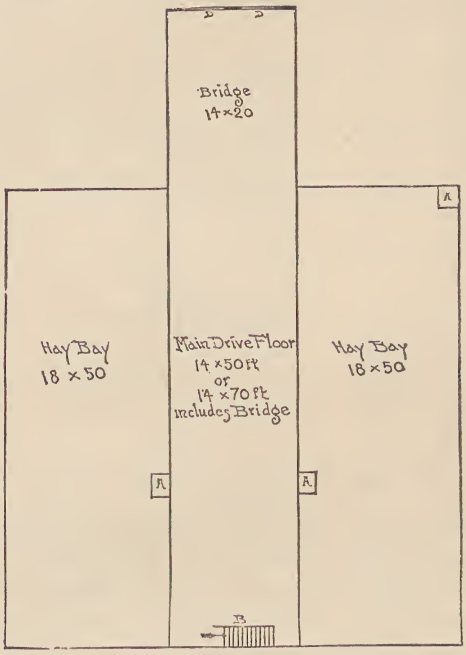


Fig. 93.—THE MAIN DRIVE FLOOR.

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three and a half feet high, serve for partitions as well. The doors and windows, *d*, *d*, and *w*, *w*, admit plenty of light and air for ventilation in summer, and the whole arrangement allows of "soiling" cattle where this is practiced. For fastening cows I prefer a chain or rope around the neck fastened to a large ring sliding up and down on an upright round post. Figure 96 shows the sub-

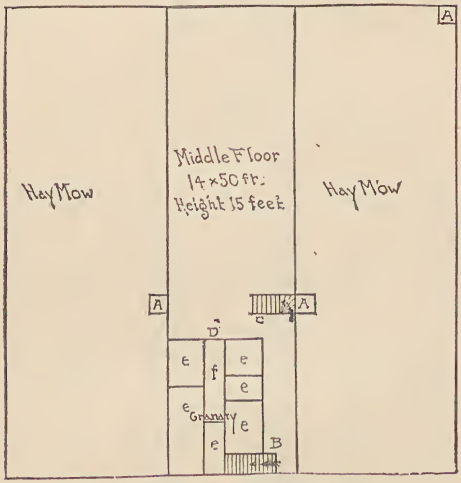


Fig. 94.—MIDDLE OR FEED FLOOR.

basement, its entrance being at the lower end, as shown by the large doors in figure 91. This is only twenty-four feet wide and thirty-two feet long. The entrance is at least ten feet wide, with two hinged doors, or one sliding one. The driveway is inclined downward from the entrance, the manure carts being backed in for loading. *M*, *m*, *m* show the manure as dropped through from *m*, *m*, in figure 95 ; it is of course spread out along the sides and at the rear as it accumulates. The posts, *p*, *p*, are on firm, solid bases, to support the weight above, as these, or their continuation, extend up to the roof. Windows, *w*, *w*, in the walls or underpinning, supply air currents

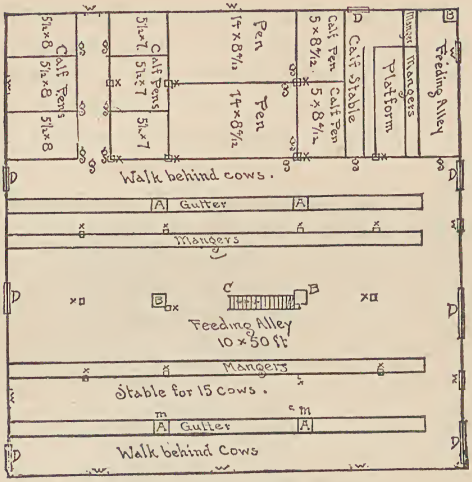


Fig. 95.—THE CATTLE FLOOR.

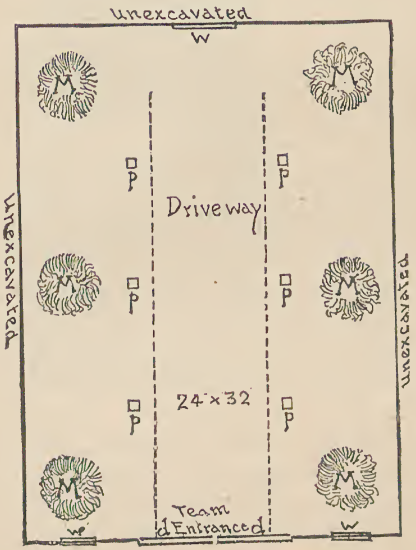


Fig. 96.—THE MANURE CELLAR.

through the cellar. This manure cellar, to which some object, I consider one of the best features of such a barn, after a dozen years of experience. I would much sooner risk cattle over them than without them, for the reason that they can be kept cleaned out in summer, and have currents of pure air constantly flowing through, while the ordinary stable floors are seldom water-tight, but more or less of the liquid manure leaks through and accumulates for years, gathering in sickening pools and sending up anything but healthful effluvia. Except where the cost of excavating is very great, in rock and hard pan, this building can be erected for from two thousand to two thousand five hundred dollars, covered with matched pine boards, painted outside two coats, and finished inside in good shape. The cost will depend upon location, price of material, whether timber and lumber is supplied on the farm, etc.

DESIGN XX.

A GRAIN AND STOCK BARN.

This design is of a barn recently erected by Prof. S. Johnson at the State Agricultural College Farm, near Lansing, Mich. The building is for storing hay and grain, with basement so arranged that a good part of it may be used for keeping live stock. The front elevation of the barn is shown in perspective, and the rear end and other side are also given. With these engravings, very little is required to be said as to the construction of the barn and its general appearance. In the plan of the basement there is provision for two rows of cattle stalls.

A silo, fifteen by eighteen feet, for the preserving of grain fodder, occupies one corner. The two small squares, four by four feet, show the position of ventilators, which also serve as chutes for the descent of hay, straw, etc. The second floor has a drive-way, fourteen by

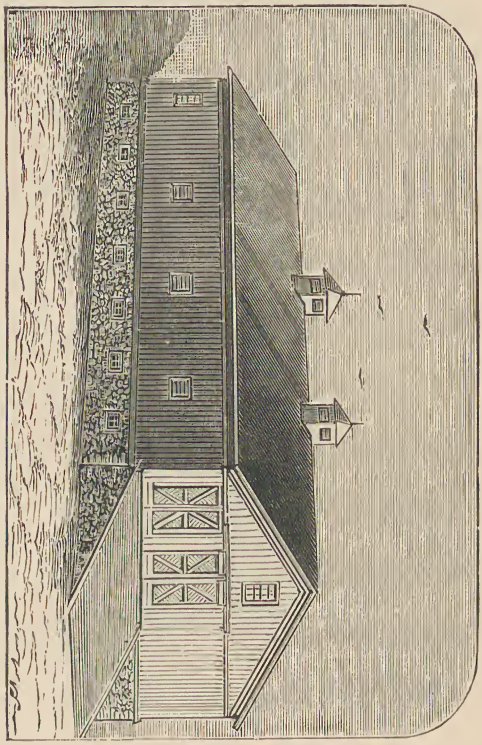


Fig. 97.—FRONT ELEVATION OF THE BARN.

eighty feet, running the whole length near the center of the barn, with a tight floor above with the exception of sixteen feet. On one side is a large bay going down to the basement floor. The granary, thirteen by twenty-two feet and ten feet high, occupies one end of the wheat

mow. It is ceiled with matched oak. The mow is thirteen by fifty-eight feet to the top of the granary, where it extends the whole eighty feet, or length of the barn. The position of the stairway to the basement is

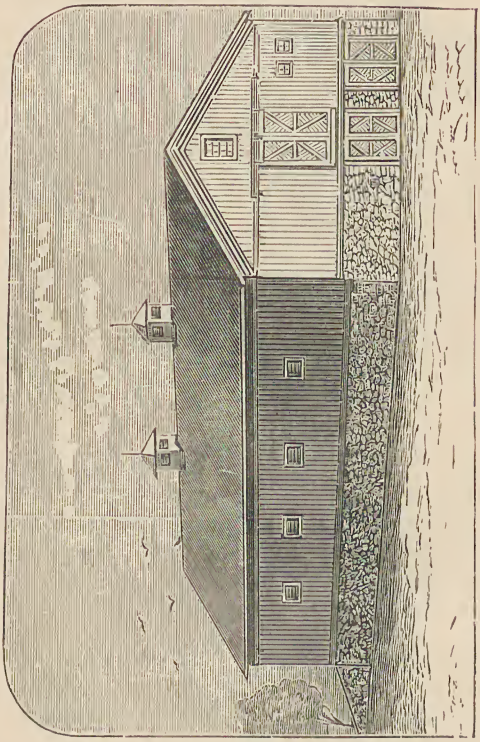


Fig. 98.—REAR ELEVATION OF THE BARN.

shown at one end of the bay, and by the side of the driveway near the entrance doors.

Professor Johnson, in his notes accompanying the the architect's plans, says: "The drive-floor runs the long way of the barn, to give room for the machine and straw-carrier inside when threshing. The grain will be

stored in the mow and above the drive-floor on the south end. In threshing, the straw-carrier will convey the straw to the floor over the north end of drive-floor, from

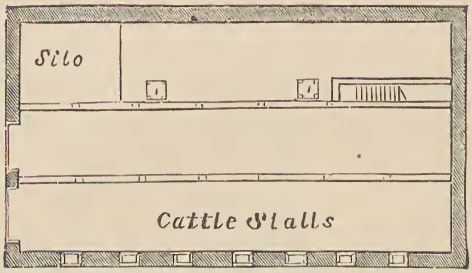


Fig. 99.—PLAN OF THE BASEMENT.

which it will be distributed to the bay, so as to keep all straw inside. The mow will then be clear to receive corn, straw, and other forage crops. The cost of the

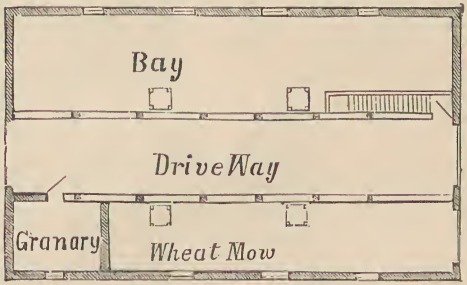


Fig. 100.—PLAN OF MAIN FLOOR.

barn, with two coats of paint, will be about eighteen hundred dollars."

DESIGN XXI.

A LARGE FARM BARN, COSTING $2,000.

The elevations show the exterior of this barn, and a plan shows the main floor, in which *g* is a grain bin, with

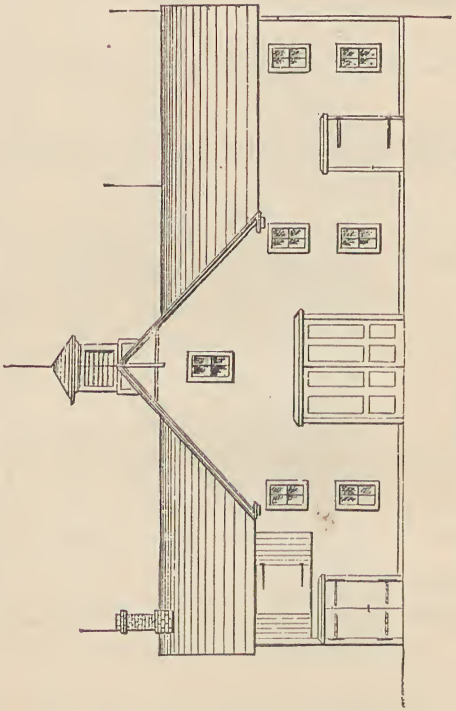


Fig. 101.—FRONT VIEW OF LARGE FARM BARN.

chutes to the floor below; *t*, opening for filling steam chest; *s*, hay chutes; *r*, *r*, *r*, openings in floor for handling the hay. The granary has chutes to feed the mill below. The ensilage cutter is on this floor, and is run by shafting from the engine room. In the plan of the

feeding floor the steam chest is at *a*; *b*, small boiler; *c*, carpenter's bench; *e*, elevator from root cellar; *m*, *m*, mixing trough; *l*, stairs to granary; *f*, to cellar; *w*, *t*,

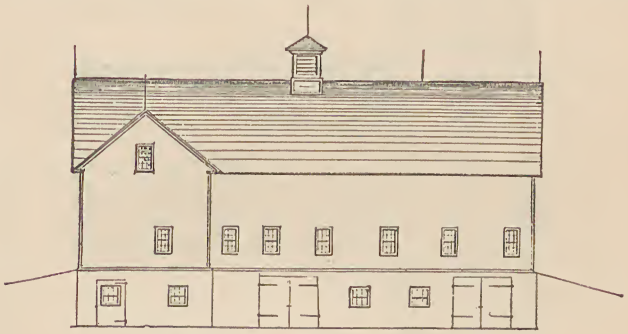


Fig. 102.—SIDE VIEW OF BARN.

water trough; *lb*, loose boxes; *s*, hay chute to cellar; *t*, trap-door; *r*, trap to root cellar; *h*, harness closet; *y*, water tank for cattle; *x*, *x*, *x*, manure traps. The en-

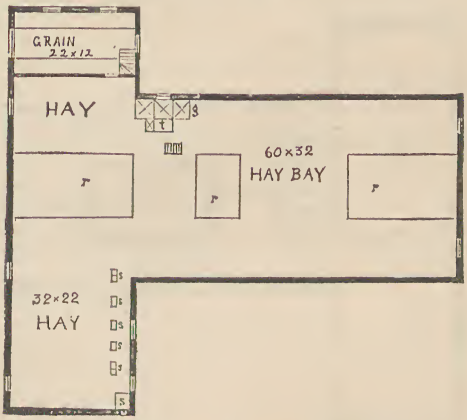


Fig. 103.—MAIN FLOOR OF BARN.

gine room contains a portable feed mill and a forge. The tool room is large enough to contain all the farm

machinery when stored at the close of the season. The floor of this room and all the space over the unexcavated

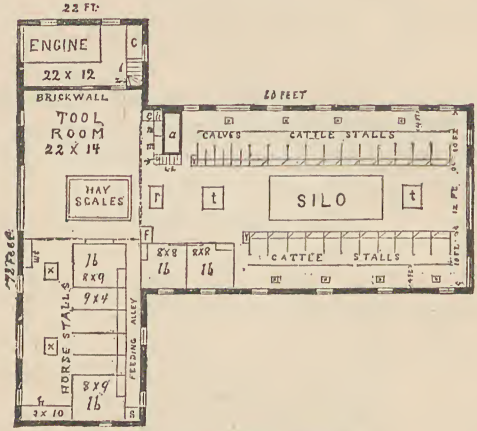


Fig. 104. - THE FEEDING FLOOR.

portions are of concrete. The silo is filled from the floor above, or the feeding floor, as desired. Each floor is

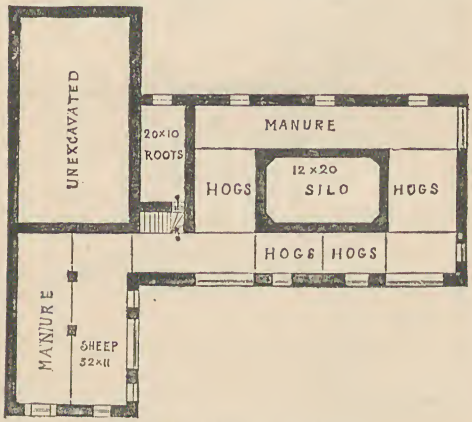


Fig. 105.—CELLAR OF BARN.

nine feet in clear, with front and rear doors twelve feet wide. The arrangement of the stalls and mangers for

cattle is shown in a separate plan and side-view. The galvanized trough, *t*, is for water. The manger fronts are set in cleats, and may be moved to shorten or lengthen the stalls. A plan of the cellar is also given. All par-

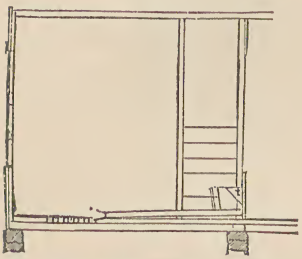


Fig. 106.—SIDE VIEW OF STALLS.

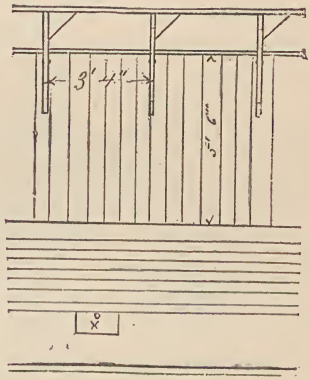


Fig. 107.—PLAN OF STALLS.

titions are movable, for access of carts to any part for removing manure. The portion under the horse stable would make a warm hen-house in winter.

COST OF MATERIALS AND LABOR.

2,600 feet 4 by 6 inch posts, spruce, 18 feet,	1,328 feet 2 by 6 inch rafters, 24 feet.
2,000 feet 4 by 6 inch sills, spruce.	864 feet 2 by 6 inch rafters, spruce, 18 feet.
1,200 feet 3 by 6 inch plates, spruce.	1,000 feet 2 by 6 inch stall posts, etc., spruce.
2,600 feet 2 by 6 inch floor joist, spruce, 12 by 16 feet.	4,000 feet 3 by 4 inch braces, girts, etc.

Total, 15,600 feet, at $16	$ 249.60
4,500 feet 6 by 6 inch sills, chestnut	112.50
60,000 shingles, at $3	180.00
6,000 feet hemlock roof, at 14 cents	84.00
9,000 feet matched pine, at 25 cents	225.00
4,000 feet matched spruce, at 22 cents	88.00
4,000 feet 2 inch matched spruce, at 16 cents	64.00
100 yards concrete, at 50 cents	50.00
1,500 brick, at $10	150.00
36 windows, at $2, $72.00 11 windows, at $1, $11.00	83.00
2 double slide doors, $25.00; 16 pairs hinges, at $1.25, $20.00	45.00
1 ventilator	20.00
200 lbs. white lead, at 62 cents	15.00
8 gallons oil, at 7½ cents	4.96
400 feet mouldings, at 2½ cents	10.00
140 cds. stone work	140.00
Carpenters' work, $350.00; Brick work, 105.00	455.00
Painting, one coat, $30.00; Nails, etc., etc, $35.00; Gutters, etc, $15.00	80.00
Total	$2,056.06

The engine, feed mill, etc., are not fixtures. A watering arrangement would cost about $1 per stall.

DESIGN XXII.

A VERY COMPLETE BARN.

This barn, recently built for Judge Charles L. Benedict, of the U. S. District Court, at Far-view, Richmond Co., N. Y., may be said to be one of the most complete structures of the kind in the country. The basement contains a vegetable cellar, a cow stable, ten feet high, with two box stalls, stanchions for twenty-four cows, stairway, room behind the stalls, and a driveway between. The main story has single stalls for four horses, a box-stall, harness, feed, and tool rooms, and a calf-pen. Here are the threshing-floor and passages, space for stairways, ventilators, and two mows for hay. The third story has a granary and a large storage loft. The dimensions upon the ground plan are thirty-six by seventy-six feet, and eighteen feet high, from top of stone wall to top of plate. These are the smallest dimensions that would give the required accommodations. The foundation walls are two feet in thickness, built of good field stone, hammer-dressed, so as to secure a flat bed; all well bonded, laid in mortar composed of best freshly-burnt Rosedale cement and clean, sharp sand, in the proportion of one part of the cement to two parts of sand. The walls are laid to a line on both faces, grouted, and the joints flushed full of mortar, all neatly pointed on the inside and thoroughly plastered on the outside. Suitable blue-stone door and window sills are set and built in the masonry in the usual way; flag-stone footings are set in cement, for the foundation of the basement posts which support the girders. The bottom of the entire basement is paved with small cobble stones well pounded down, covered with a concrete floor six inches in depth, made of freshly-burnt Rosendale cement

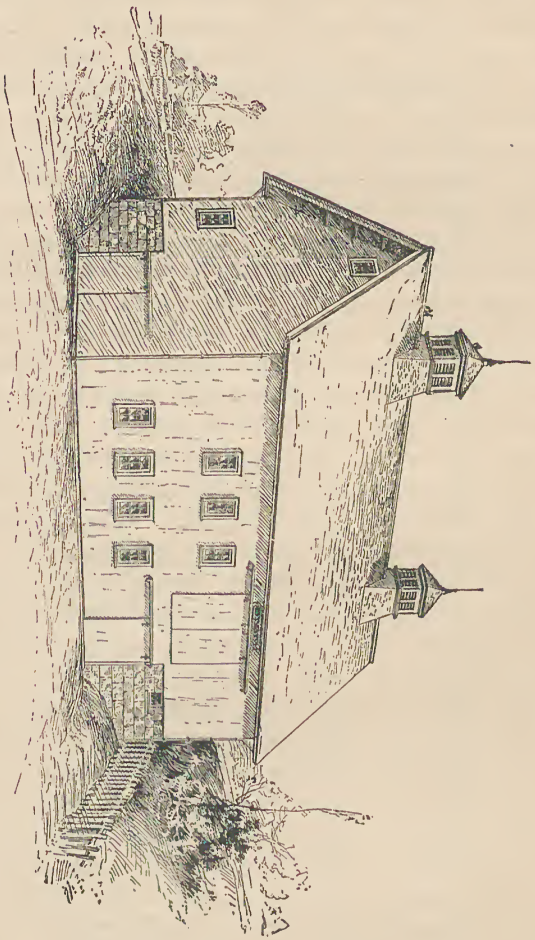


Fig. 108—FAR-VIEW BARN—SEEN FROM A NEIGHBORING HILL.

and clean, coarse sand and gravel. These ingredients were mixed dry upon a plank bed, using one part of the cement to two parts of the sand and gravel. This concrete was laid down in board moulds, rammed well in place, and brought to a true surface. Gutters, eighteen inches in width, graded so as to carry off the liquids, are formed behind the cow-stalls. At the lower ends of each, a cast-iron stench-trap is set and connected with a vitrified earthen drain pipe, which connects with a manure pit, about one hundred feet distant. Suitable timbers are bedded in the concrete, to receive the nailing for the necessary woodwork. The ground is excavated so that the side and end towards the barn-yard are built of wood to within one foot of the ground: an eight-inch brick wall is built under this part so as to raise the sill eight inches above the top of the concrete. The framing timber is of sound, seasoned, yellow pine and spruce, sawed square and true, and all framed, braced and pinned together with dry hard-wood pins. The exterior side walls are covered with one-inch dry, merchantable, white-pine, rabbeted siding, put on vertically, and securely nailed to each girth, and the joints battened with white-pine moulded, mill-worked battens, nailed to each bearing with two ten-penny finishing nails. The roof is covered with one-by-six-inch rough hemlock fence boards, placed two and one-half inches apart, and shingled with best quality eighteen-inch white-pine shingles, laid five and one-half inches to the weather. The cornices are formed by nailing tongued and grooved boards upon the rafters, with the surfaced side down. The ventilators have white pine louvres on each side, as shown in figure 108.

The cattle stalls in the basement are floored with two-inch planking, firmly nailed to the bed pieces. A layer of salt is put between the concrete and floors, to prevent rotting. The mangers are built of dry, white pine. A strong plank stairway, from the basement to the main

floor, is inclosed with tongued and grooved dry pine ceiling boards, with a door at the bottom, hung with strong

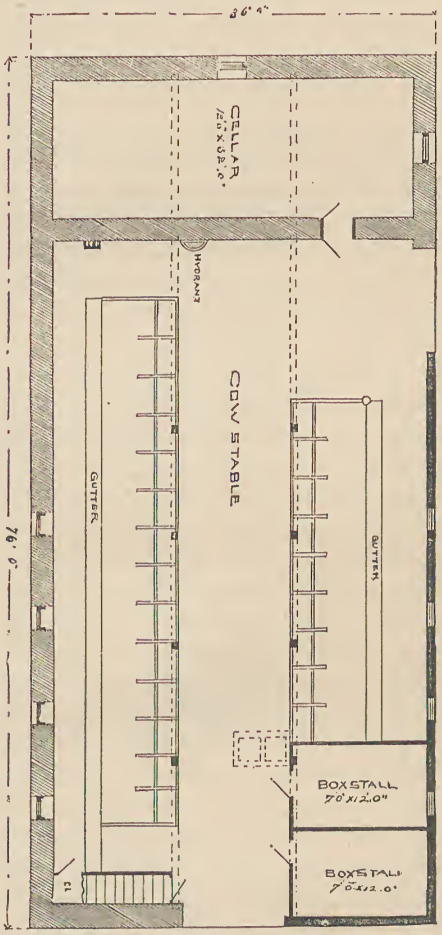


Fig. 109.—BASEMENT.

iron butts, and provided with a spring to hold it closed. Around the opening in the harness room is a neat railing.

The floor of the main story is of two-inch tongued and grooved spruce plank, surfaced on one side, well driven together, and nailed to each joist with twenty-penny nails. The floors under the horse-stalls and calf-pen are dropped below the level of the main floor, and a bed of concrete five inches deep, composed of best Portland cement and sand is laid on top of the planking. A cast-iron open gutter, set in the concrete, connects with an iron soil pipe, which leads to the manure pit.

The partitions between the horse stalls are of two-inch, tongued and grooved spruce plank, with the tops covered and the outer ends let into a groove in eight-inch turned posts, which are secured firmly to the floor. A band of iron is screwed to the tops of these partitions, to prevent horses from gnawing them. Each stall is floored with two-inch rough plank, so arranged that it can be removed when desired. The side walls, ceiling and floor of the granary are of tongued and grooved, dry, sound hemlock; the space between the studding is filled in with concrete eight inches high, to prevent the working of rats and mice. All outside walls of the horse stalls, and partitions of harness room, tool-room, ventilators, calf-pen, hay mows, closets, and inclosing of stairs, are of dry, tongued and grooved, surfaced pine. The storage loft is floored with dry, tongued and grooved spruce. One side of the ventilator over the stable is used as a hay chute, with a series of doors arranged to open at different hights, in which to throw the hay as it is required. A ladder is placed in the other compartment, for the purpose of ascending to the storage loft. Three chutes to the vegetable cellar are made, with trap-doors accessible from the threshing floor. The eave troughs are so graded, as to conduct the water from the center of the eaves to a conductor, placed at each corner of the building.

An eight-horse power steam engine is placed in the tool room, which furnishes power to operate a grist-

mill, corn-sheller, feed-cutter, grind-stone, wood-saw, and threshing machine, all of which are placed on the main floor—also a vegetable cutter, which is in the basement.

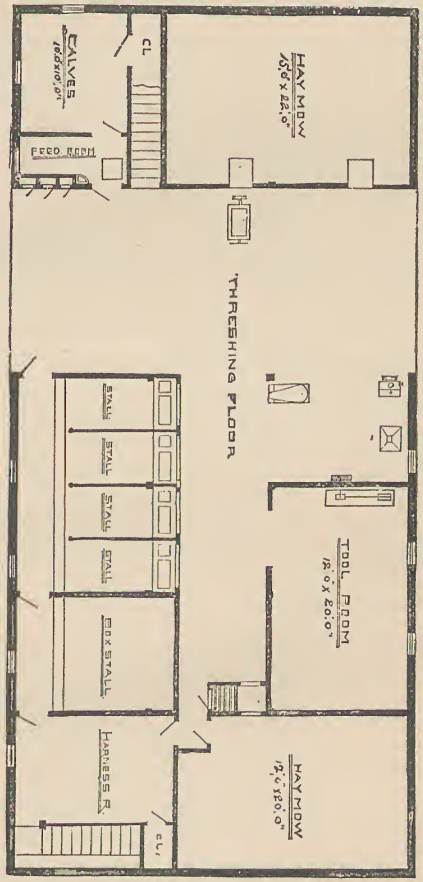


Fig. 110.—MAIN FLOOR.

A twelve-horse power tubular steam boiler is placed in a small building, eighty feet from the barn yard, which supplies steam to the engine, to a steam-pump, used to

fill the reservoir, and to a large steaming tank for cooking the feed.

A manure pit, at the lower end of the barn yard, twenty by thirty feet, by three feet deep, with walls of stone, cemented, and made water-tight, receives all the liquids from the stables. By the aid of the machinery for cutting the fodder, and the tank for cooking the same, and the manure pit to receive the compost, the percentage of waste is reduced to a minimum.

Without giving a full list of detailed expenditures, we append a condensed statement of the cost of building the above barn, including all the necessary hardware, plumbing, lumber, mason work, labor and fittings.

COST OF MATERIALS AND LABOR.

Excavations, drains, and mason work, complete	$1,500
40,000 feet framing timber, sheathing, at $20	800
8,500 feet spruce flooring, at $20	170
11,000 feet white pine ceiling boards, at $30	330
5,000 feet white pine siding, at $30	150
1,000 feet white pine battens, at $30	30
4,000 feet finishing lumber, at $40	160
27 windows, complete	150
Hardware and stable fittings	275
Plumbing	60
Cartage	256
Painting	225
Carpenter work and labor	1,833
Incidentals	61
Total	$6,000

DESIGN XXIII.

A MICHIGAN BARN REMODELED.

The old barn, figures 111 and 112, was thirty-four feet by forty-eight feet, with sixteen-feet posts, and built the

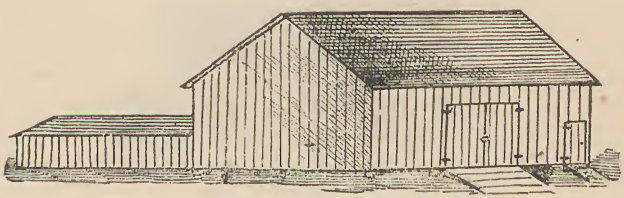


Fig. 111.—FRONT AND END VIEW OF OLD BARN.

usual way, with four bents. The threshing floor was twelve feet wide, with the stables on one side and hay-mow on the other. There was a shed in rear of barn, twelve by thirty feet. The sills of the barn rested on oak blocks, about one foot above the ground. In remodeling, the main building was raised two feet from the ground, a

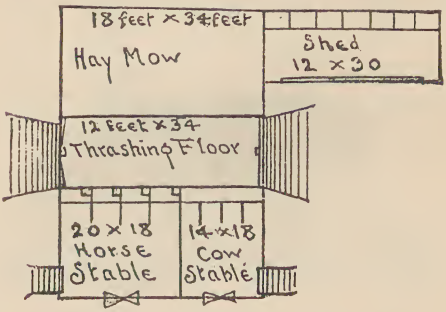


Fig. 112.—GROUND PLAN—OLD BARN.

stone foundation one foot thick being laid all around, and extending two feet into the ground, to be below frost. The threshing floor was raised two feet above the sills, and the ground excavated two feet under it. Cross-walls

were then built, making a cellar twelve by thirty-four feet, and six feet high. There are two small windows in front, and a door in rear of cellar. A foundation, similar to that under main barn, was then built for a wing thirty-four

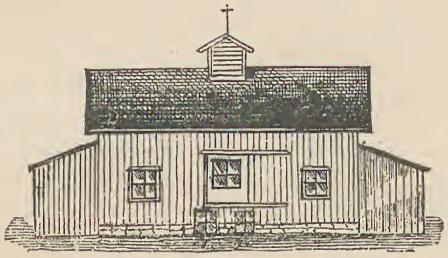


Fig. 113.—REMODELED MAIN PART WITH SHEDS.

feet wide, and extending three feet back from main barn. The wing is same hight as the barn, with roof hipped into main roof, and a ventilator built in the center of roof, as seen in figures 113 and 114. The old shed was moved to rear of the wing, and continued around each way fifteen feet on each side of wing, as seen in figures 114 and 115.

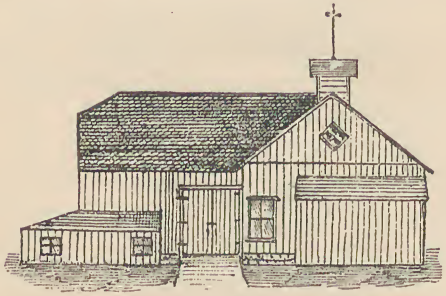


Fig. 114.—ELEVATION OF REMODELED BARN.

A new shed was built on each end of the main barn, twelve by twenty-four feet, open in rear, the lower part for manure, and the upper part for bedding, as shown in the figures 113, 114, and 115. The stables are twelve by twenty

feet, with stalls for horses and five cows. An alley four feet wide runs along in front of mangers for feeding. At the front end a door opens into the granaries. A harness room four by fourteen feet is convenient to horse stable. A box stall, nine by fourteen feet, next to cow stable, is used for cows with calf. An entrance way closed by a gate, allows access from stables to threshing floor. Floors over stables, granary, and threshing floors, admit storage

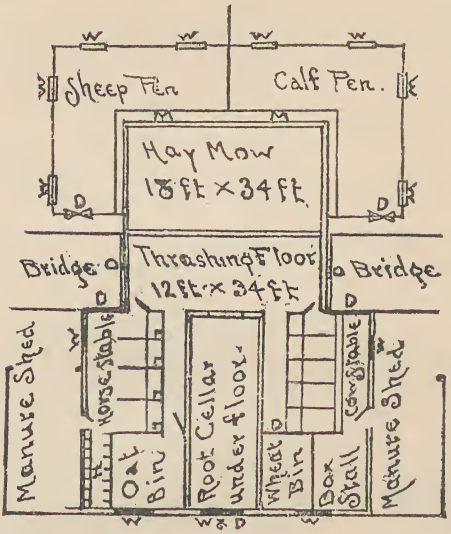


Fig. 115 —GROUND PLAN OF NEW BARN.

of un-threshed grain or hay. At the front of the barn is a sliding door with a large window in it for admitting light and air. The walls of granaries are made of two-by-four scantling, laid flatways one on top of another. Stables and granaries are eight feet high. The whole remodeled barn is painted red with white trimmings.

COST OF MATERIALS AND LABOR.

Sills, 6 by 8 inch, two 30 feet long, and four 34 feet long, 784 feet; sills for shed, 6 by 6 inch, 606 feet; posts, 8 by 8 inch, six, 16 feet long, and three 12 feet long, 704 feet; girths, 6 by 6 inch, two each of 18, 17, and 12 feet length, 282

feet; plates, 6 by 6 inch, two 40 feet and two 34 feet, 444 feet; three beams, 6 by 8 inch, 34 feet long, 408 feet; thirty-five joists, 12 by 2 inches, 18 feet long, 1,260 feet; scantling, 2 by 4 inches, for sheds, etc., 5,000 feet; rafters, thirty-two, 2 by 4 inches, 22 feet long, 402 feet; planks for floors and bridges, 4,200 feet.

Total timber, 14,000 feet, at $15	$210.00
Shingles, 20,000, at $3	60.00
Stock boards, 3,000 feet, at $20	60.00
Roof boards, 7,000 feet, and battens, 704 feet, at $10	77.04
Windows, nails, and trimmings	50.00
Carpenter work, $150; painting, $75	225.00
Excavation, 60 yards, at 20 cents	12.00
Stone for foundation, 1,506 cubic feet at 6 cents	90.00
Total cost of remodeled barn	$784.04

DESIGN XXIV.

A NEW ENGLAND BARN REMODELED.

Figure 116 shows an old New England barn, which furnished a fair amount of shelter to a few head of live stock.

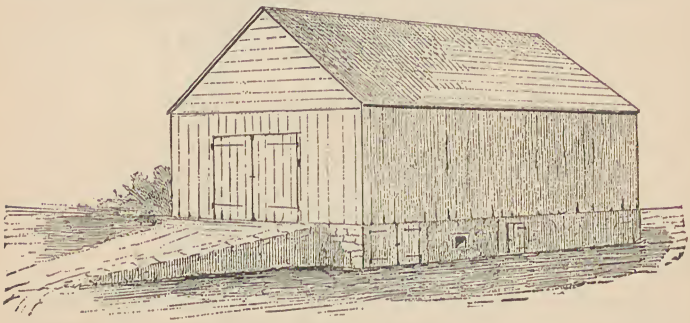


Fig. 116.—THE OLD BARN.

It was inconvenient for winter work, and had no provision for thee conomical saving of manure. Figures 117 and 118 show the interior of the old barn. An addition, figures 119 and 120, sixteen by sixteen feet, was erected; a second floor for storage of fodder was put on, and the cattle stable transferred from the cellar to the ground floor. With

these changes, the barn accommodates more stock, with ample storage room, light, and ventilation. The exterior of the remodeled barn is show in figure 122, and the interior

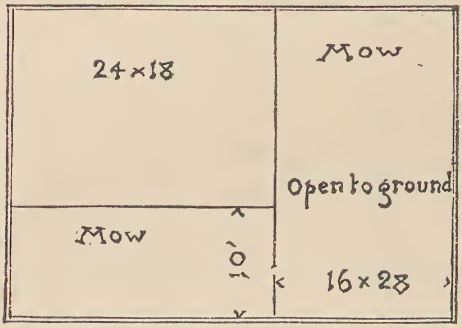


Fig. 117.—HAY FLOOR OF OLD BARN.

in figures 123 and 124. The cellar (figure 121) is arranged for storing roots, which are put in through a chute near the end door; it also contains a silo (filled from the feeding

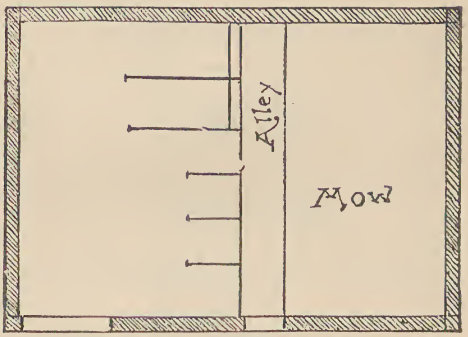


Fig. 118.—BASEMENT OF OLD BARN.

floor), manure pits, and a wagon shed. The old barn was not wide enough, and an addition along one side secures two rows of cattle stalls, if desired. The frame of the old barn was sound, and required no important

changes. The materials used in the main building are as follows:

4,400 feet matched siding, at $25	$110.00
1,900 feet chestnut plank, for floor, at $25	47.50
1,900 feet spruce flooring, at $22	41.80
24,000 shingles, at $3.50	84.00
600 feet spruce plank, for stalls, at $20	12.00
1,000 feet, 2 by 6, spruce joist, at $16	16.00
250 feet, 3 by 4, spruce stall posts, at $16	4.00
2 large doors	25.00
Cupola ventilator	20.00
Stone work in silo	50.00
600 feet siding	15.00
168 feet, 4 by 6 bottom sills and posts	2.69
684 feet, 2 by 6 studs, rafters, etc	10.94
256 feet spruce flooring	5.63
500 feet spruce plank for horse stable	12.50
3,500 shingles	12.25
Total	$469.31

The skilled labor necessary to remodel the barn should

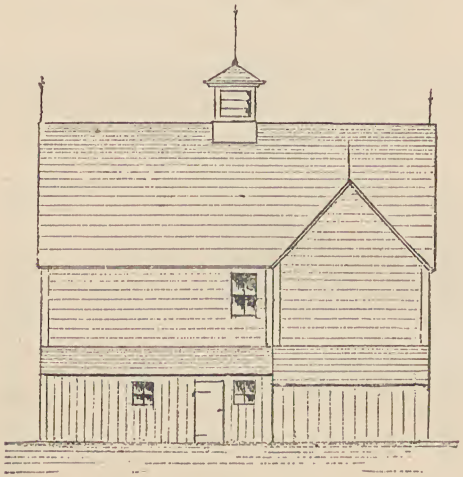


Fig. 119.—END VIEW OF WING.

not cost over one hundred dollars. To this add twenty-five dollars for hardware, and fifty-five dollars and sixty-nine cents for items, as glass, etc., not above mentioned, and we have the grand total of six hundred and fifty dollars for the cost of reconstruction. This estimate of

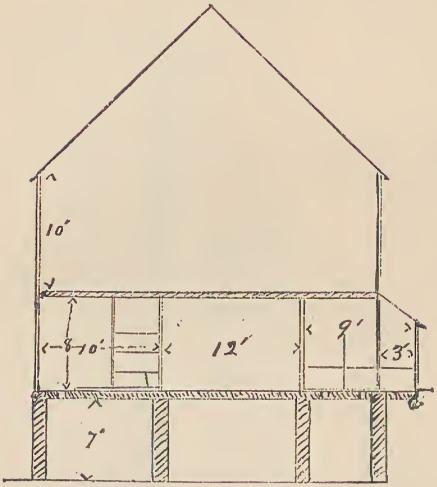


Fig. 120.—CROSS-SECTION OF WING.

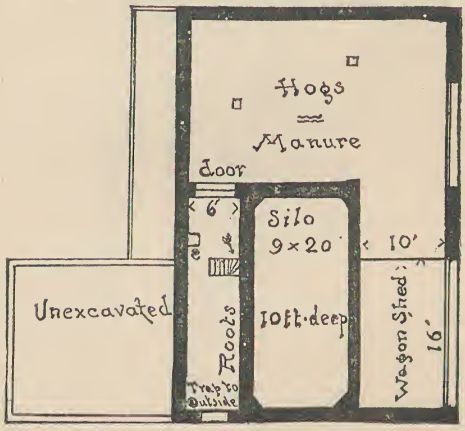


Fig. 121.—PLAN OF CELLAR.

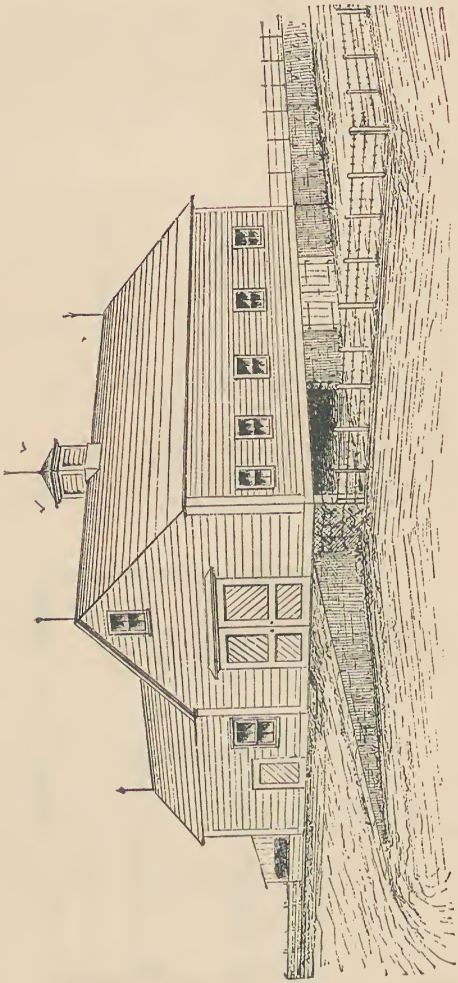


Fig. 122.—PERSPECTIVE VIEW OF A REMODELED BARN.

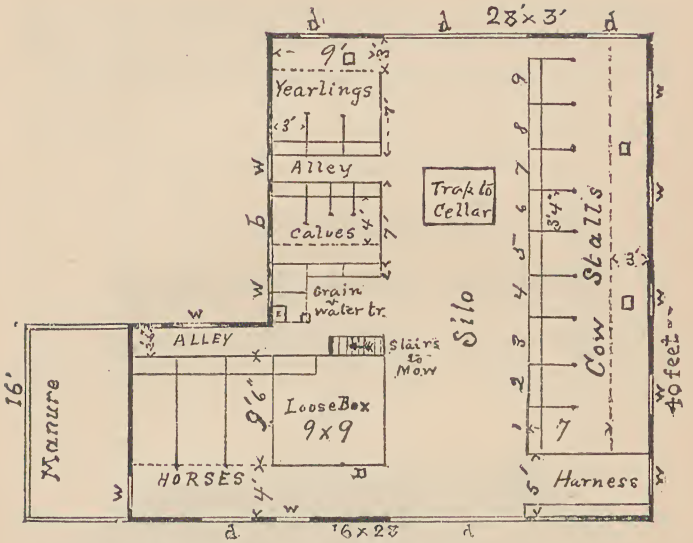


Fig. 123.—FEEDING FLOOR OF A REMODELED BARN.

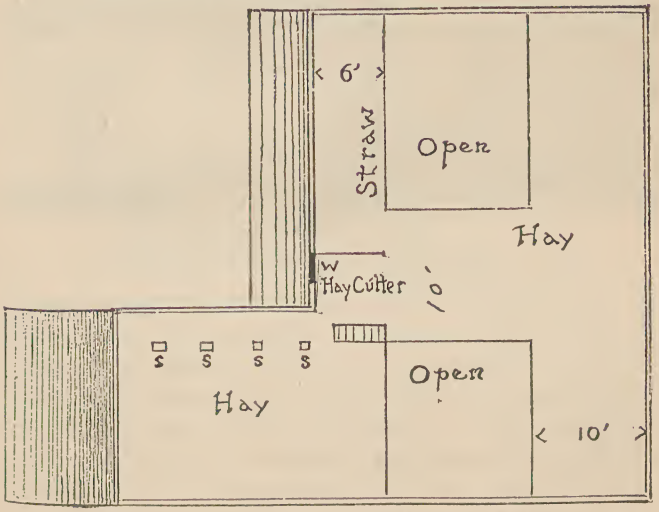


Fig. 124.—HAY FLOOR OF A REMODELED BARN.

expenses can only be general, and is mainly intended to show that the changes are important ones, easily made, and within reach of many farmers having poor barns.

DESIGN XXV.

A COMBINED CORN CRIB AND GRANARY.

The corn crib and granary measure twenty by thirty feet on the ground, with ten-feet posts. The corn crib

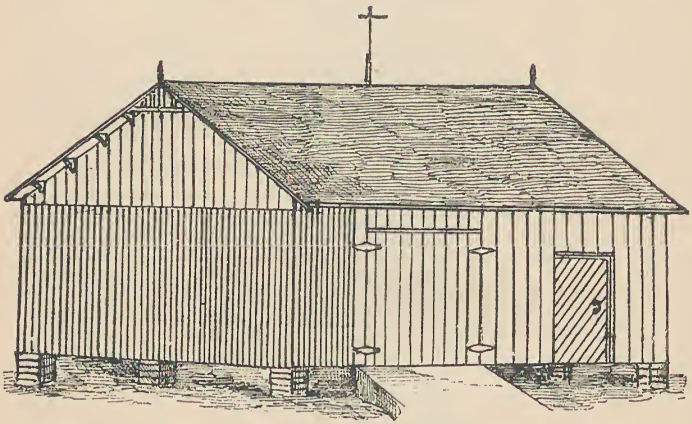


Fig. 125.—THE EXTERIOR OF CORN CRIB AND GRANARY.

part is fourteen by twenty feet, with a driveway through the middle, eight feet wide. The corn crib is five feet wide below and six feet at the top, eight and a half feet from the floor, and will hold about six hundred and thirty-four bushels of corn. The long side-box upon the floor is twelve inches wide and very convenient for removing corn. There is room over the driveway and granary for storing about one thousand bushels of corn. Figure 127

shows the arrangement for taking the corn out of the crib; figure 128 is a cross-section of the same.

The granary is sixteen by twenty feet; the inside is boarded up with planed and matched maple boards. It has six bins five by six feet, which will hold about seven

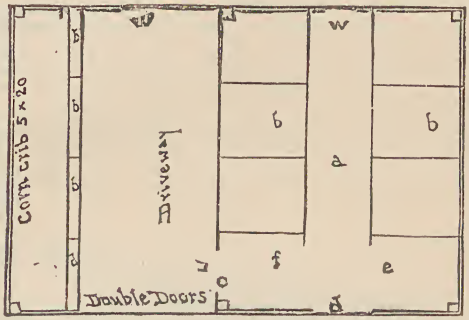
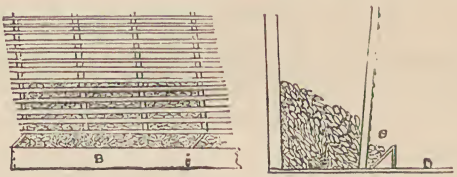


Fig. 126.—INTERIOR OF THE GRANARY.

hundred and ninety-two bushels of grain; or one hundred and thirty-two bushels in each bin. The bins are made of maple boards, planed and matched. The alley, *a*, is three and a half feet wide and runs to the back part of the granary. There is room in front at *e* and *f*, five feet wide for the fanning mill, platform scale, bag holder and



Figs. 127 and 128.—VIEWS OF THE CORN BINS.

truck, grain measures, bags, scoops, etc. The floor of the granary is of one and a quarter inch maple planks, planed and matched. The floor of the corn crib is of one and a quarter inch red oak planks, unplaned and matched. The door at *d* is convenient when carrying the corn to the granary as it is shelled.

DESIGN XXVI.

PLAN OF SHEEP BARN.

The main building in this plan is twenty-four by forty feet, with twenty-foot posts, and is used for hay from the ground up, the hay being unloaded from the west end (outside), with a horse fork and hay carrier projecting outside four feet, on the end not shown in the elevation. There is a large door in the west end. The wings, sixteen

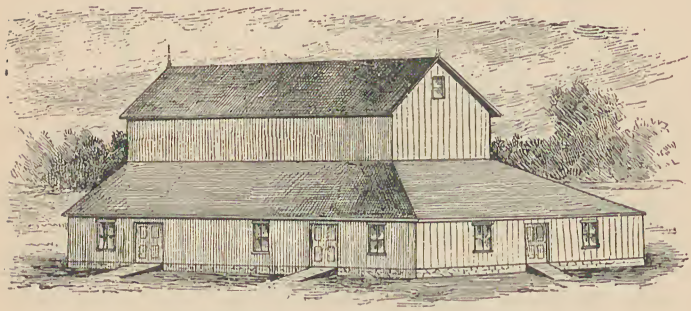


Fig. 129.—EXTERIOR OF SHEEP BARN.

feet wide and seven feet high at the low side, extend around three sides of the main building, and are divided as shown in the ground plan. The merits claimed for this plan are: that the hay being built on the ground, saves expensive frame-work, posts, and floor, such as are necessary to support the hay when the sheep are in the lower part of the barn—besides, the greater the depth of hay, the more the building will hold in proportion to space; that, the hay being in the center, it is more convenient to feed to the sheep in the different pens; and that it gives plenty of yard room on the different sides of the building. A room can be made for storing grain,

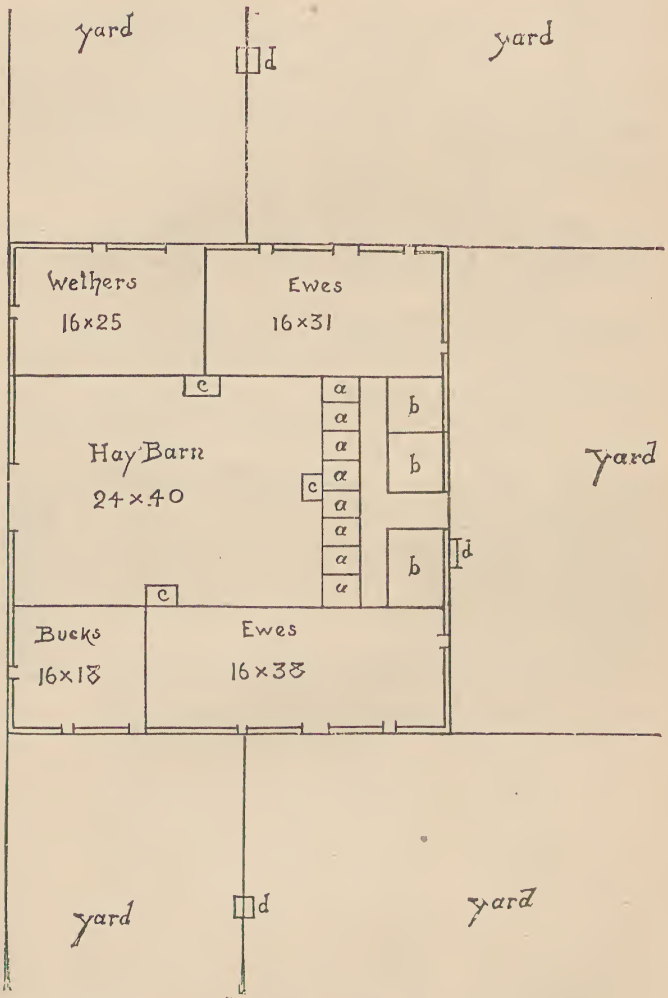


Fig. 130 —GROUND PLAN OF SHEEP BARN, WITH YARDS.

hay, and wool, overhead, in the sheep-sheds, if thought desirable.

There are no floors in either the main building or sheds. The barn is graded up a few inches with earth or gravel, which keeps it perfectly dry. It will accommodate from one hundred and seventy-five to two hundred sheep of the mutton breeds.

COST OF MATERIALS AND LABOR.

Sills for Main Building.

2 pieces, 6 by 6 inches by 22 feet, 132 ft.
2 pieces, 6 by 6 inches by 20 feet, 120 ft.
4 pieces, 6 by 6 inches by 24 feet, 288 ft.

Sills for Sheds.

3 pieces, 4 by 6 inches by 30 feet, 180 ft.
3 pieces, 4 by 6 inches by 28 feet, 168 ft.
7 pieces, 4 by 6 inches by 16 feet, 224 ft.

Posts.

8 pieces, 6 by 6 inches by 20 feet, 480 ft.
2 pieces, 6 by 6 inches by 16 feet, 96 ft.

Beams.

2 pieces, 6 by 6 inches by 24 feet, 288 ft.

Girts.

18 pieces, 4 by 4 inches by 14 feet, 336 ft.
12 pieces, 4 by 4 inches by 12 feet, 192 ft.

Plates.

2 pieces, 4 by 6 inches by 22 feet, 88 ft.
2 pieces, 4 by 6 inches by 20 feet, 80 ft.

Rafters.

42 pieces, 2 by 6 inches by 16 feet, 672 ft.

Studding for Sheep Sheds.

40 pieces, 2 by 6 inches by 7 feet, 280 ft.

Girts and Plates.

12 pieces, 2 by 6 inches by 18 feet, 216 ft.
6 pieces, 2 by 6 inches by 20 feet, 120 ft.

Rafters.

67 pieces, 2 by 6 inches by 20 ft., 1,340 ft.
Common lumber for partitions, etc ..... 600 ft.

Total, 5,900 feet, at $15	$ 88.50
Roof boards, 4,000 feet, at 10 cents	40.00
Stock boards, 4,100 feet, at 20 cents	82.00
Battens, 700 feet, at 25 cents	17.50
Shingles, 360 squares, at $3	108.00
Carpenter work	150.00
Nails, windows, and trimmings	50.00
Painting	50.00
Stone underpinning, two cords laid	15.00
Total cost	$601.00

DESIGN XXVII.

A SHEEP BARN.

The sheep barn here shown is adapted for using the horse fork while storing the hay in the loft. There is not a single cross beam in the way. The barn is sixty

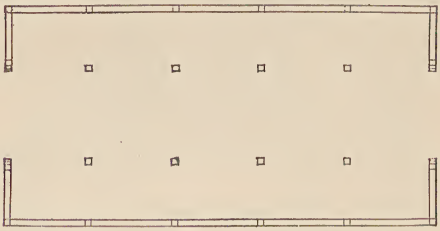


Fig. 131.—GROUND PLAN OF SHEEP BARN.

feet long and thirty feet wide. The first story is ten feet high, and the ridge-pole thirty-five feet. Forty tons of hay can easily be stored in the loft from either end, without a man being needed to pack it away. This is more than enough for the two hundred sheep which this

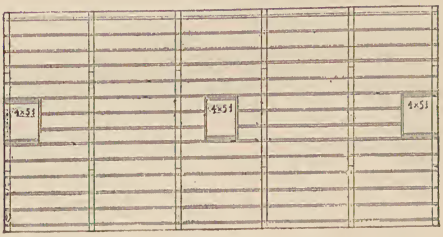


Fig. 132.—PLAN OF FLOOR.

barn will accommodate. The hay is thrown into the pens below as needed. The rectangular spots shown in the ground plan, are twenty-four stone posts, which are each four feet long, eighteen inches across at the base, and

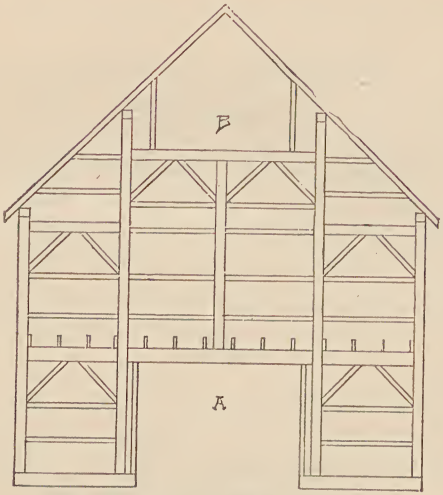


Fig. 133.—AN END BENT OF BARN.

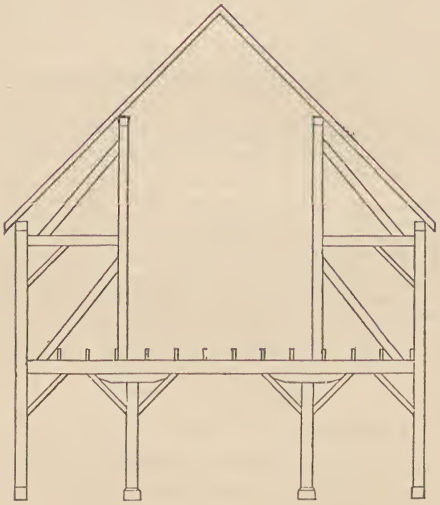


Fig. 134.—MIDDLE BENT OF BARN.

tapering to twelve inches at the top. Brick piers may be used where suitable stones are absent. The floor plan shows the joist bearers and hay chutes. The bent on the west end is shown, in which *A* is the door on the ground floor, and *B* the hay loft door, which is ten by ten feet, and is let down on the outside by a small rope and pulley.

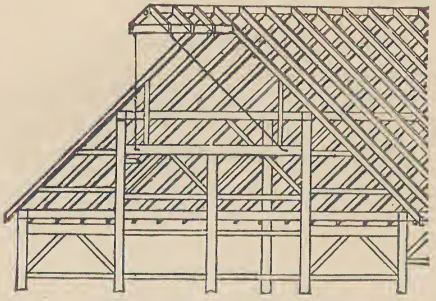


Fig. 135.—END FRAME WORK.

These hay doors, one at each end, are held by guides nailed to the weather boards, and a "stop" at the lower end. One of the four middle bents, with its standing braces, purline posts, etc., is also shown. These timbers are fitted with dove-tail tenons. The framing of one side of the barn from the sill to the plate, with all the cross-

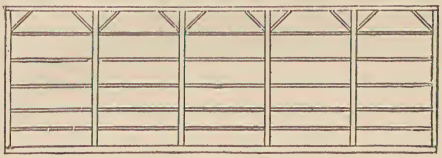


Fig. 136.—FRAME WORK OF SIDE.

pieces, is shown on a reduced scale, and there is a perspective view of the framing of the western end, showing the projecting support for the horse hay fork. The ends of the roof project, as seen, to furnish an attachment for the horse fork. The track, or "railway," extends from this back into the loft for twenty-six feet. Upon this

projection the hay is lifted perpendicularly, instead of being drawn against the end of the barn. The supports for this extension are two strong rods, extending to a girder six inches to the right and left of the doors.

The following estimates are for substantial oak frame, and No. 1 pine siding and shingles. Oak siding and oak lap shingles would lessen the cost.

COST OF MATERIALS AND LABOR.

2 sills, 10 by 10 inches by 37 feet.	4 plates, 7 by 8 inches by 37 feet.
2 sills, 10 by 10 inches by 25 feet.	4 plates, 7 by 8 inches by 25 feet.
4 sills, 10 by 10 inches by 9 feet.	2 end girders, 8 by 8 inches by 14½ feet.
4 joist beams, 8 by 12 inches by 30 feet.	70 joists, 2 by 9 inches by 12 feet.
4 joist beams, 8 by 12 inches by 8 feet.	32 end nail ties, 4 by 4 inches by 8 feet.
2 joist beams, 8 by 12 inches by 14½ feet.	50 nail ties, 4 by 4 inches by 12 feet.
8 caps, 8 by 8 inches by 5½ feet.	4 nail ties, 4 by 4 inches by 7 feet.
8 middle posts, 8 by 10 inches by 9 feet.	4 nail ties, 4 by 4 inches by 4 feet.
4 dover posts, 4 by 8 inches by 9 feet.	4 gable door posts, 4 by 4 in. by 5½ ft.
12 side posts, 8 by 8 inches by 20 feet.	62 rafters, 2 by 5 inches by 12 feet.
4 purline posts, 8 by 8 inches by 26 feet.	62 rafters, 2 by 5 inches by 11 feet.
2 center purline posts, 8 by 8 inches by 14½ feet.	29 brace pieces, 3 by 4 inches by 10 ft.
8 purline posts, 8 by 8 inches by 18 feet.	1,800 feet oak flooring for hay loft.
12 shed ties, 8 by 8 inches by 8½ feet.	4,200 feet pine siding.
8 standing braces, 6 by 8 inches by 10 ft.	6,820 feet lath.
8 standing braces, 6 by 8 in. by 10½ feet.	22,816 shingles.

14,522 feet oak timber, at $12 50	$181.20
1,800 feet oak flooring, at $12	21.60
4,200 feet pine siding, at $24	100.80
22,816 pine shingles, at $4.50 per 100	102.67
5 kegs nails, at $3.50	17.50
8 pairs of hinges, at 50 cents	4.00
Carpenter work	175.00
Excavating and stone work	25.00
Total cost	$616.67

DESIGN XXVIII.

A PRIZE PIGGERY.

The size of this piggery is twenty by forty-five feet. The yard-doors, *a*, *a*, *a*, in the ground plan, are two and one-half by three feet, and raised by cords from the passage way. The doors, *b*, *b*, are for the passage of the visiting hogs. There is a sliding door placed at the end of the piggery against which a wagon may be backed for loading and unloading. The passage way doors, *c*, *c*, are hung with strap hinges, fastened with hooks and staples.

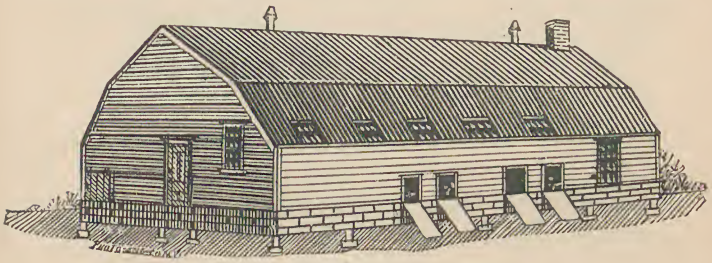


Fig. 137.—EXTERIOR OF PIGGERY.

There are five windows on the south side, made with sliding sashes. On the north end of the building, over the pens, is a floor of matched boards, eight feet wide and thirty-two feet long, and six feet above the main floor. This furnishes abundant store room for corn, etc. The floor in the kettle room is laid with seven-eighths inch hemlock boards. The floors of the pens are of two inch matched planks, with the cracks well filled with coal tar, and raised two inches above the passage. There is a cellar under the kettle room for storing roots. It has a twelve inch wall laid in cement, and a double bulkhead door, through which the roots are taken. The balance of the building rests on stout chestnut posts, and is planked

up on the outside to the sills. The outside of the piggery is clapboarded with spruce, and the roof is covered with pine shingles. Two ventilators made of tin, run through the ridge of the building. The chimney starts from the bottom of the cellar and reaches three feet above the roof. The partitions on both sides of the passage way, and between the pens, are made of two inch plank, three and

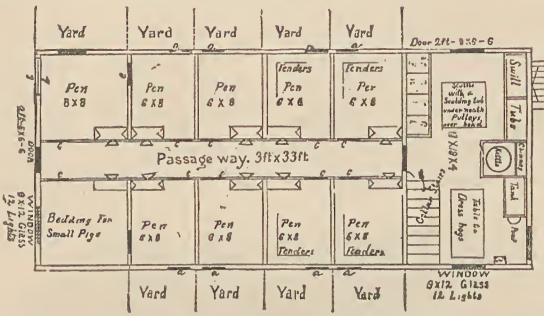


Fig. 138.—GROUND PLAN OF PIGGERY.

one-half to four feet high. There is a trap door over the cellar doors, and above this a pole with hooks, upon which to hang dressed hogs.

COST OF MATERIALS AND LABOR.

2 sills, 6 by 6 inches, 45 feet long.
3 sills, 6 by 6 inches, 29 feet long.
2 sills, 6 by 6 inches, 32½ feet long.
8 sills, 6 by 6 inches, 8½ feet long.
24 floor pieces, 2 by 6 inches, 5½ feet long.
2 floor pieces, 2 by 6 inches, 16 feet long.
1 passage way sill, 6 by 6 in., 3½ ft. long.
6 pieces floor timber, 2 by 8 inches, 8 feet long.
10 pieces floor timber, 2 by 6 inches, 11 feet long.
26 pieces studding, 2 by 4 in., 6½ ft. long.
15 end studding, 2 by 4 in., 15 ft. long.
4 plates, 2 by 4 inches, 45 feet long.
46 rafters, 2 by 4 inches, 6 feet long.
46 rafters, 2 by 5 inches, 10 feet long.
10 partition pieces, 2 by 4 in., 12 ft. long.
11 pieces upper floor timber, 2 by 5 inches, 8 feet long.
1 piece upper floor timber, 2 by 5 inches, 33 feet long.

Total framing timber, 3,000 feet, at $14	$ 42.00
24 chestnut posts, at 15 cents	3.60
500 feet hemlock plank, at $13	6.50
1,320 feet grooved pine plank, at $16	21.12
440 feet grooved pine plank, at $14	6.16
910 feet plank, at $13	11.83
120 feet, 2 by 2, hard wood	1.20
275 feet sheathing, spruce, at $15	4.12
220 feet hemlock boards, at $12	2 64
1,700 feet hemlock boards, at $12	20.40
6,500 shingles, at $3.50	22.75
600 feet clapboards, at $2	12.00
3 windows and frames, 9 by 13 glass	6.00
Brought forward	160.32

Carried forward	160.32
5 windows and frames, 8 lights	7.50
2 outside doors and frames	4.00
800 chimney bricks, at $5	4.00
1 cask lime	1.00
2 ventilators	1.50
10 troughs	3.00
Nails, hinges, etc	15.00
Cement for cellar, and labor	35.00
Laying brick	2.50
Carpenter work	40.00
Items not classified	5.00
Total	$278.82

DESIGN XXIX.

PLAN OF A PIGGERY.

The main building is sixteen by thirty-six feet, with

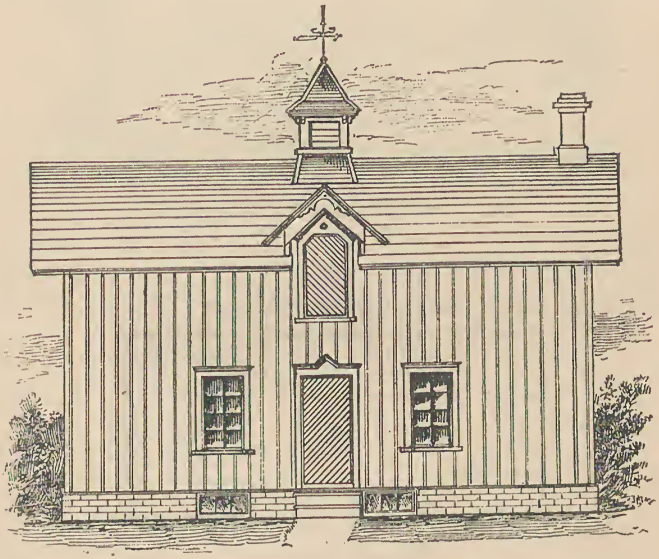


Fig. 139.—FRONT ELEVATION OF PIGGERY.

sixteen-foot posts. The extension for pens is fourteen by thirty-six feet, and eight feet high on the back side.

The sills and joist of the pen part are of white oak or other durable timber. Other timber may be pine, spruce, or hemlock. The siding is one by twelve inch stock

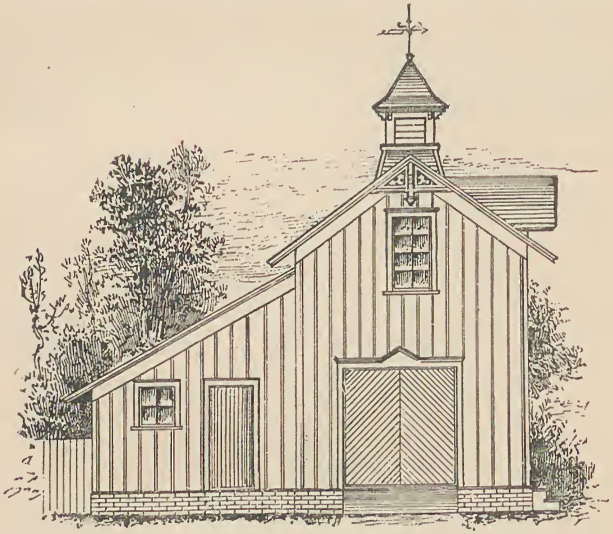


Fig. 140.—SIDE ELEVATION OF PIGGERY.

boards battened; cornice about eighteen inches projection; roof covered with good quality cull-boards and best eighteen inch cedar or pine shingles. There is a ven-

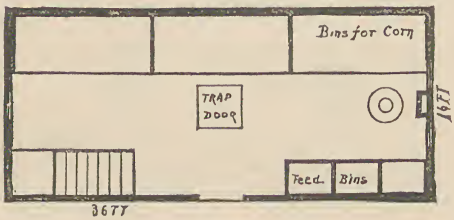


Fig. 141.—THE LOFT.

tilating cupola as shown on elevations. Sliding doors connect each pen with the yards in the rear; they are also in the partitions between pens and on the left side, as shown

in the side elevation, and also in the plan of the main floor. The main floor is designed to be used for scalding and dressing, and should be of matched boards, put together with thick paint to make it water-tight. It may be "deafened" to exclude frost from cellar, by putting

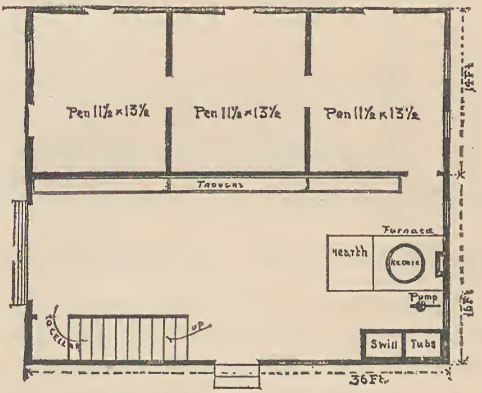


Fig. 142.—THE MAIN FLOOR.

about two inches of coarse mortar on rough boards between the joists. The cellar-way should be ceiled inside and filled in with the same material. The feeding-troughs should be of hard-wood and constructed as shown in detail. The doors, when hanging perpendicular, shut

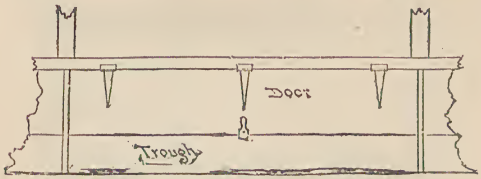


Fig. 143.—FRONT OF TROUGH.

the hogs from the trough, and admit of filling, and when swung out and fastened by a button to the front of the trough, they allow the hogs to feed. The cellar, cistern, and foundation walls are of field stone laid in

mortar; the cellar bottom is "grouted" and provided with a drain if necessary. Plaster the cistern with cement mortar, and the ceiling of the cellar with the same material. The opening to the cistern on the outside is closed with a door. The furnace and kettle may

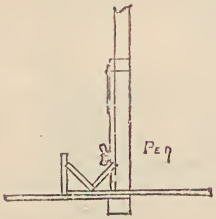


Fig. 144—TROUGH CLOSED TO HOGS.

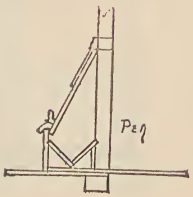


Fig. 145.—TROUGH OPEN TO HOGS.

be cast-iron, portable; or the kettle may be set in brick. A sheet-iron funnel, well painted, should be set in the loft floor, connected by a pipe to the chimney to carry off steam, etc., from the kettle. The outside of the piggery is painted with two coats to suit the owner. The build-

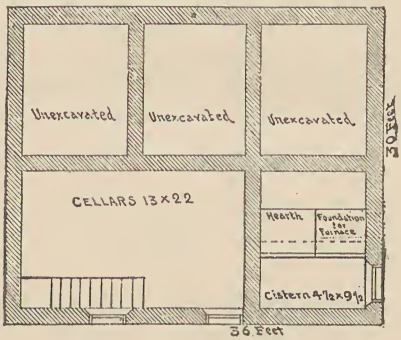


Fig. 146.—PLAN OF CELLAR.

ing may be put up for considerably less money by omitting the cellar and cistern, and finishing in a cheaper manner.

COST OF MATERIALS AND LABOR:

3 sills, 8 by 8, 36 feet long.
2 sills, 8 by 8, 30 feet long.
2 sills, 8 by 8, 16 feet long.
2 sills, 8 by 6, 14 feet long.
8 posts, 6 by 8, 16 feet long.
2 posts, 6 by 6, 10 feet long.
4 posts, 6 by 6, 8 feet long.
4 beams, 6 by 8, 16 feet long.
4 beams, 6 by 6, 14 feet long.
3 plates, 6 by 6, 36 feet long.
100 joist, 2 by 8, 12 feet long.
56 rafters, 2 by 4, 12 feet long.
4 rafters, 2 by 6, 12 feet long.
20 rafters, 2 by 6, 18 feet long.
30 pieces, 4 by 4, 14 feet long.
50 pieces, 4 by 4, 12 feet long.
20 pieces, 4 by 4, 16 feet long.

Amounting to 6,650 feet, at $17	$113.05
1,700 feet roofing, at $12	20.80
11,500 shingles, at $4 50	52.75
3,500 feet stock boards, 1 by 12, dressed, 16 feet, at $18	63.00
1,800 feet battens, 16 feet, at $8	14.40
1,200 feet, 2 by 12 plank, 14 feet, at $17	20.80
1,100 feet, 2 by 10 D & M flooring, 16 feet, at $22	24.20
2,000 feet, 1 by 6 D & M flooring, at $20	40.00
5 windows, 8 lights, 12 by 14 glass, at $2.25 each	11.25
5 windows, 4 lights, 12 by 14 glass, at $1.25 each	6.25
2 cellar windows, 2 lights, 12 by 12, double glazed	1.50
Carpenter work	125.00
Nails and trimmings	30.00
Eave troughs and pump	15.00
Excavating and stone work	75.00
Furnace, kettle, and chimney	35.09
Painting outside	35.00
Total	$683.00

DESIGN XXX.

A COMPLETE FRAME PIGGERY.

The piggery shown in this plan is fourteen by forty feet; corner posts, fourteen feet; hight of first story, eight

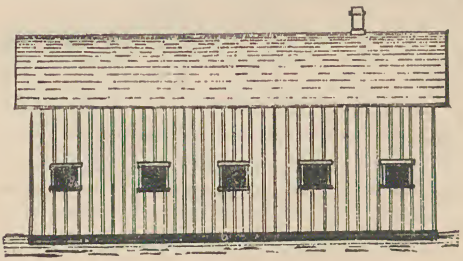


Fig. 147.—SIDE OF PIGGERY.

and one-half feet; second story, five feet from floor to top of wall plate. The first floor has two thicknesses of inch

boards, a foot wide, the lower boards running lengthwise of the building and the upper ones crosswise. The walls also are two layers of similar boards, the outside ones perpendicular, and battened with inch strips three inches

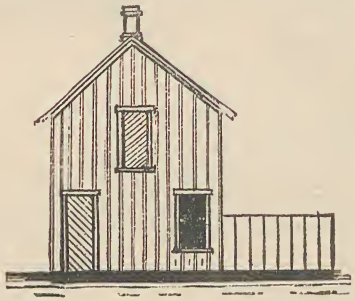


Fig. 148.—END OF PIGGERY.

wide. Second story floor is one thickness of narrow inch boards, tongued and grooved. Stairs to second story three feet wide. All the doors are battened. One twelve-light window in gable end, and one in feed room. Each pen has a window opposite it, across feeding hall, and a sliding sash at the rear. Between each pen and its yard

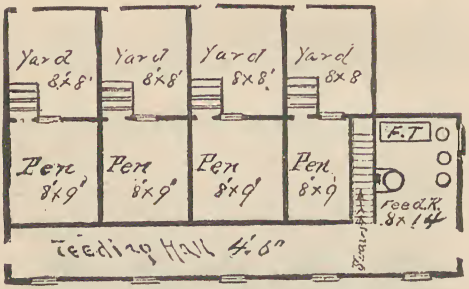


Fig. 149.—GROUND PLAN OF PIGGERY.

is a batten sliding door two and one-half feet wide, four feet high, and at the outside of each yard is a door three by six feet, either on hinges or to slide. Hight of yard fence, six feet. From each yard to its pen is an incline of two inch plank, with inch strips three inches wide

well nailed on to prevent pigs from slipping. The feed troughs run across at the front. The partitions, five feet high. Between the pens and over or in front of the troughs, are swinging doors. The hinged stick, *A*, props

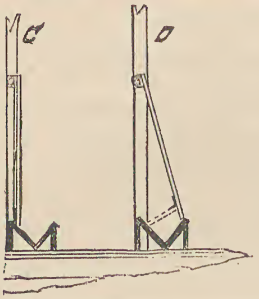


Fig. 150.—SECTION OF TROUGHS.

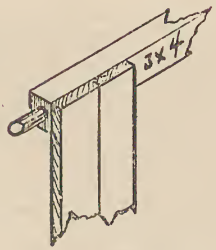


Fig. 152.—HINGE OF SWINGING DOOR.

the swinging door back, when cleaning out troughs and supplying feed. It falls back on removing the stick. The partitions dividing the pens and yards can be made either stationary or to swing, the latter being preferable,

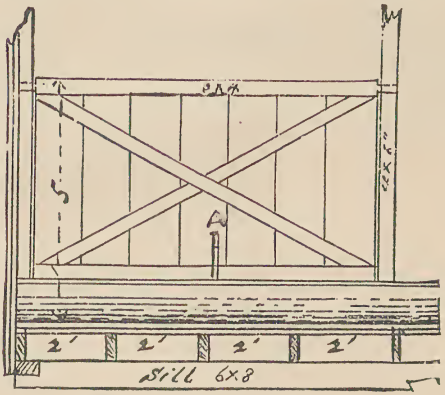


Fig. 151.—FRONT OF TROUGH.

as this will allow all the pens to be thrown into one large one, and the same is true of the partitions in the yards. The feed room is provided with a brick chimney, an iron

kettle, a large wooden box for mixing feed, slop barrels, etc. The entry doors to this are made wide, to admit a slop barrel on a wheelbarrow. If the yards are planked on a level with the floors, the incline can be dispensed with.

COST OF MATERIALS AND LABOR.

Timber:	
2 sills, 6 by 8 inches, 40 feet long (or shorter ones spliced), 281 feet.	
2 sills, 6 by 8 inches, 14 feet long, 151 feet.	
4 corner posts, 4 by 4 inches, 14 feet long, 75 feet.	
2 plates, 3 by 4 inches, 40 feet long (or shorter ones spliced), 89 feet.	
2 plates, 3 by 4 inches, 14 feet long, 28 feet.	
5 pieces for swinging partition posts, 4 by 6 inches, 8 feet long, 30 ft.	
10 posts for outside partition walls, 4 by 4 inches, 8 feet long, 107 feet.	
14 fence posts, 4 by 6 inches, 8 feet long, 224 feet	
42 floor joists, 2 by 8 inches, 14 feet long, 882 feet.	
42 rafters, 2 by 4 inches, 11 feet long, 308 feet.	
21 pieces, 2 by 4 inches, 8 feet long, 112 feet.	
8 pieces, 4 by 6 inches, 14 feet long, for joist beams, 224 feet.	
27 pieces for ledgers and frame rails, 2 by 4 inches, 16 feet long, 238 feet.	
Total framing timber, 2,848 feet, at $14	$ 39.87
Rough boarding, 1 inch thick.	
968 feet sheathing	
1,120 feet flooring (1 foot wide, 14 feet long).	
3,220 feet weather-boarding	
1,312 feet for swinging partitions, fence, troughs, etc.	
124 batten pieces, 1 by 3 inches, 14 feet long, 434 feet.	
76 pieces, 3 inches wide, 8 feet long, for braces for swinging partitions, 203 feet.	
Total, 7,257 feet, at $17	123.34
800 feet dressed lumber, 1 by 4 or 6 inches, tongued and grooved, for doors and second floor, at $20	16.00
5,000 shingles, at $390	19.50
2 windows, 12 lights, 8 by 10 inches	3.00
10 windows, 6 lights, 8 by 10 inches (sliding sash)	7.50
3 door frames, 3 feet by 6 feet 8 inches	5.25
Bricks for 8 by 8 inch flue, etc	26 30
Hardware, sash hinges, nails, etc	5.00
Materials for painting and labor	10.00
Carpenter work	110.48
Total cost of piggery	$366.24

DESIGN XXXI.

KEEPING POULTRY ON A LARGE SCALE.

The keeping of poultry in large numbers seems to be a very difficult matter, for poultry farms are rare, and farmers appear to be rather averse to such enterprises. That poultry in large numbers are as profitable as when but few are kept, has been demonstrated to my own satisfaction by carefully conducted experiments, extending over a period of over twenty years: but after many losses and disappointments I have come to the conclusion that, no matter how favorable the conditions, poultry cannot profitably be kept in large numbers, except by division into families not exceeding one dozen in each. This proposition I am sure can be verified by thousands of our farmers, who are aware that a larger proportion of eggs are obtained from small flocks than from large. Writing, as I do, especially for farmers rather than for fowl fanciers, and while I shall endeavor to show how poultry may be made profitable when bred and sold for ordinary purposes, I admit the value of all that has been done by those who have been energetic in improving and perfecting the different breeds of fowls.

THE PROPER SIZE OF FLOCKS.

With the exception of the additional labor and quarters necessary, it is as easy to keep a thousand hens as a dozen, but we must at the outset give up the idea of allowing large numbers to run together at will, as the past has demonstrated this method to be erroneous. The general absence of large flocks indicates that farmers consider poultry as of minor importance, while in fact there is nothing produced on the farm that pays a greater percentage upon the capital invested than fowls. To suc-

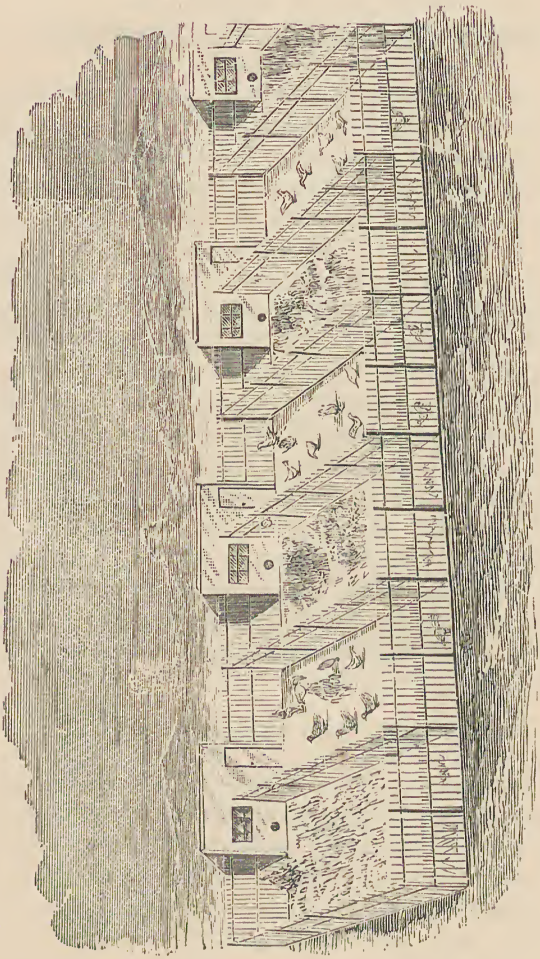


Fig. 153.—ARRANGEMENT OF POULTRY HOUSES WITH TWO YARDS TO EACH.

ceed, instead of ranging in crowds, over large areas, fowls should be divided into families of about twelve, never exceeding fifteen. Each flock must possess a poultry-house and two yards. The object of two yards is to allow of high cultivation and cleanliness, and to secure freedom from disease.

POULTRY HOUSES AND YARDS

should be as little expensive as possible, and farmers need not be alarmed at what seems a great cost, as it is really insignificant in comparison with the advantages; and all need not be erected at once. There are many ways

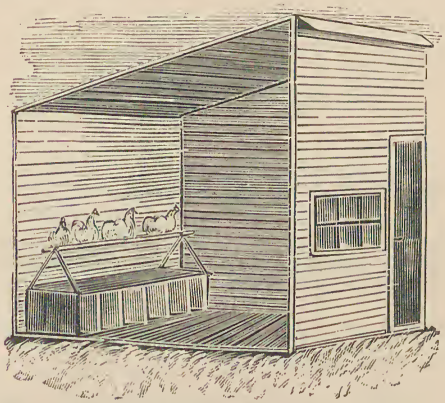


Fig. 154.—SINGLE HOUSE, WITH END REMOVED.

of erecting a cheap poultry-house, and each individual may have his own methods, which may be superior to that here given. For a cheap affair, I purchase cheap but serviceable material. For a dozen hens, a house ten by ten feet square is quite large, and if kept clean, six by six feet is not too small. My houses are small, being eight feet high in front, and five at the back. Each house is made of weather-boarding all around, the roof being made in same manner, as the high pitch carries off all rains. Each has a door, consisting of a solid twenty

inch board, and a glazed sash in front for light. The houses face the south. The top board in front is hinged, in order to open or close for ventilation. The window-sash is taken out in summer, and a wire screen substituted. The house has two openings into the yards, one of which is closed when the yard to which it belongs is not used by the fowls. The cost of such a building is about five dollars for material in this section, where lumber sells for twenty dollars per thousand. Each house has a board floor, and the nests are along the sides; for a dozen fowls, a row at the back and on one side is

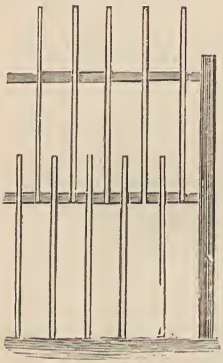


Fig. 155.—SECTION OF FENCE.

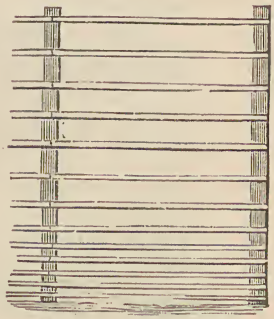


Fig. 156.—LATH FENCE.

sufficient, as seen in the sketch of a single house, where the interior is exposed by removing one of the sides. The nests are covered by a wide board, over which is a perch for roosting. This economizes space. The wide board receives the droppings, and facilitates their removal, while the fowls can not injure themselves in getting on or off the roost. The floor is likewise clean, and crowding together is prevented. The nests may be compared to a long box with the front taken off. The partitions being nailed to this piece, may be slid into place in the box, the front, cut a little short, forming as it were, a false bottom. The nests should be roomy; one foot

square answers. With this arrangement of nests and roost, one can enter the house at any time without fear of filth, if every morning it is cleaned out, and swept. A quantity of dry earth, mixed with a little ground plaster, should always be scattered over the floor and on the board under the roost after each sweeping. Only a few minutes are required for the work, and there is no disagreeable odor. Twice a month a good whitewashing, both inside and outside, is given, keeping away disease and vermin. A weather-boarded house is better than one perpendicularly boarded and battened, as the rain cannot enter, and it is somewhat open in summer from warping and lack of close fitting of the boards. This admits

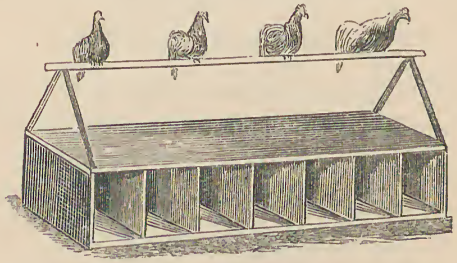


Fig. 157.—NESTS, WITH ROOSTS.

of more or less ventilation. In winter, paper the interior with two or three thicknesses of old newspapers, and the house will be warm and comfortable. On the approach of very warm weather, the paper is torn off. A coating of whitewash, to which a little glue and flour-paste is added, makes the paper lining hard and stiff.

THE YARDS.

The fences are made of lath, one hundred of which will make thirty feet of fence, when placed about the width of a lath apart. Three strips are used, the laths being nailed to the bottom and center strip; and in order to complete the hight to six feet, another row is nailed to the center and top strips, as shown by a section of the

fence. This requires, however, more laths. A cheap fence, dispensing with strips altogether, can be made by placing posts three feet and nine inches apart, and nailing the laths directly to the posts, widening the distance towards the top, as shown in another sketch. I believe it to be an error to suppose that fowls must have nice grass runs. Two yards are recommended for each house, which the fowls can occupy alternately; this allows the poultry to run in one yard, while vegetation is growing in the other for their benefit.

DESIGN XXXII.

POULTRY HOUSE IN SECTIONS.

The poultry house, shown in this design, is designed to have a central building, with as many sections added

Fig. 158.—FRONT OF POULTRY HOUSE.

on each side as may be required by the wants and circumstances of the owner. The estimates given below show that the central building will cost fifty-nine dollars and ninety-seven cents, and each added section, thirty-three

dollars and ninety cents. As indicated in figures 158 and 159, the glass fronts of the sections lean back at the top, and the front roof follows the same angle, the sash sliding up between the rafters. The main room, twelve feet square, with eight-foot posts, is for storing and preparing food, etc., dressing poultry, packing eggs, and may contain an incubator. One section might be kept for a

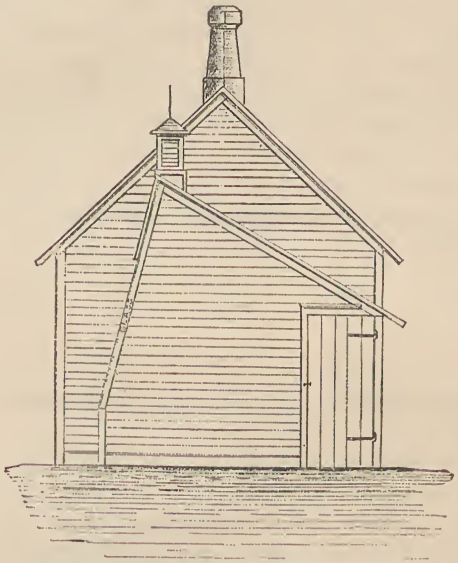


Fig. 159.—END VIEW OF POULTRY HOUSE.

hatching room. The house and sections should face the south or southeast, and its rear be against or into a bank when practicable. The elevation shows brick underpinning ; stone would be cheaper in some localities, as would be plain matched pine or plain boards and battens, instead of clapboards. Cheaper ventilators may be provided, but looks are worth a little. There is a platform under the roosts, from which the droppings are collected in the alley-way, and this should be done daily in winter. The

partitions between the alley and the roosting room are of two inch slats. The roosts should be hinged, and hook up for convenience in cleaning. The flooring of the sections is of fine gravel. Water can be conveniently supplied to the entire range by an inch pipe, with a place on each section, two feet long and four inches in diameter, open at the top, as a drinking trough ; the water to be regulated by a floating valve in the supply tank. The houses can be warmed by hot-air pipes from the main building, sunk in the gravel. The water supply pipes, if laid along these, will be kept from freezing. There should be connected with each section a yard of the same width (ten feet) and fifty feet long. The cost of each yard would be about thirteen dollars and thirty-nine cents—that is,

Fig. 160.—GROUND PLAN OF POULTRY HOUSE.

thirteen posts, at ten cents ; one hundred and forty-six feet of two by four inch joists, two dollars and thirty-four cents ; three hundred and twenty-five feet of two inch slats, eight feet long, six dollars and a half ; nails and labor, three dollars and a quarter. There ought not to be over fifteen fowls in each section, and they would do better with only eight in a section. The estimate for a section and its yard is forty-seven dollars and twenty-nine cents, or, with paint, say fifty dollars. Ten per cent. on this, or five dollars per annum, would be fifty cents a year each if only ten fowls be kept in a section, adding pro rata for the expense of the central building. Any experienced poultry raiser will readily admit that the product of fowls

thus kept separate, with abundant yard room, would be far greater than the cost.

COST OF MATERIALS AND LABOR.

Timber: 109 feet of 4 by 4 inch, for sills and posts; 120 feet of 2 by 6 inch for floor joists and plates; 136 feet of 3 by 4 inch for studs, girts, etc.;—total, 365 feet spruce, at $16	$5.84
175 feet spruce flooring, $3.85; 240 feet hemlock roofing, $3.36; 500 feet matched pine, $12.50; 2,500 shingles, at $3.25, $8.12	27.83
3½ cords stone work, $3.50; 1 foot 8 inch cement stone chimney top and pipe, complete, $5.80	9.30
2 windows, $4; 1 door, $2; 2 hinges, $1	7.00
Carpenter work and nails	10.00
Total (without painting)	$59.97

ESTIMATE FOR EACH SECTION.

40 feet of 4 by 4 inch for sills; 4 rafters 2 by 6 inch by 11 feet, and 4 by 9 feet for front (80 feet); 46 feet of 3 by 4 inch studding and girts;—total, 176 feet spruce timber, at $16	$ 2.82
140 feet hemlock roofing boards	1.96
1,500 shingles, at $3.25	4.87
50 feet roost slats, $1; 1 pair hinges, 50 cents	1.50
3 sash, at $2 25, $6.75; ventilator, $5	11.75
4 cords of stone work, at $1	4.00
Carpenter work and nails	7.00
Total, per section (without paint)	$33.90

DESIGN XXXIII.

POULTRY HOUSE—COST, $43.96.

My poultry house is used for keeping twenty-five to thirty grown fowls. For breeding, I run a partition through the center and keep eight to fifteen in each apartment, according to the breed. In this latitude it is seldom so cold that they cannot remain in the open air some part of the day. In cold, windy weather they only run in the front yard, where they keep quite comfortable, as it is closely planked on all sides except on the south, which has lattice or woven wire. The structure is sixteen feet square, facing the south. No posts are used. Scantlings cut into proper lengths are laid on the ground in shape. A couple of planks are nailed on each end and raised into position when the longer or side scantlings are set in place. The planks or boards are then all nailed

on, and the rafters are next added. These are notched to fit over both the scantling or plate, and the outside

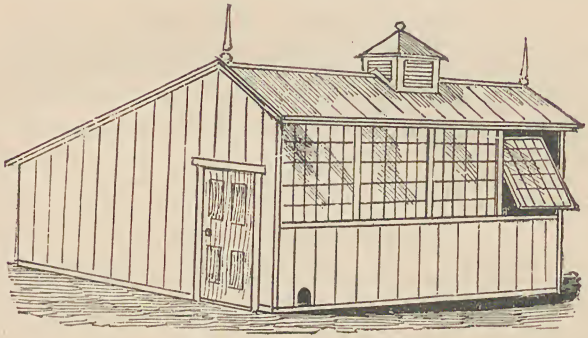


Fig. 161.—EXTERIOR OF POULTRY HOUSE.

plank. This house was built of all heart yellow pine, and required about two hundred and fifty feet of scant-

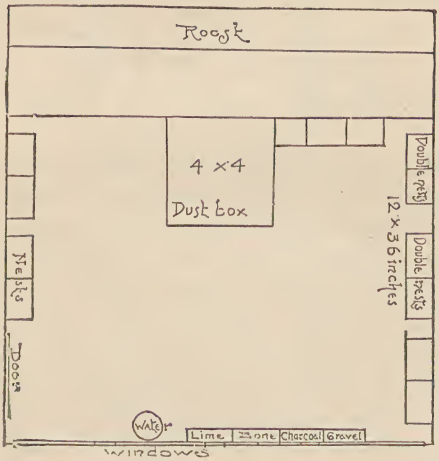


Fig. 162.—PLAN OF POULTRY HOUSE.

ling and twelve hundred feet of plank. The windows swing open as in the elevation. By adding another room, this house would hold fifty fowls.

The estimate of the materials necessary, and the cost, is as follows :—One inch boards : One thousand feet one foot wide for sides, roof, nests, etc. ; twelve base boards, six inches wide and sixteen feet long ; ten boards, three inches wide and sixteen feet long for boxes and roof strips, etc. ; six boards, four inches wide and sixteen feet long, for window casings. Seven scantlings, two by four

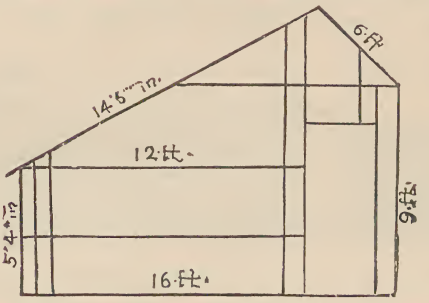


Fig. 163.—SECTIONAL VIEW OF POULTRY HOUSE.

inches, eighteen feet long ; seventeen pieces scantling, two by three inches, sixteen feet long, for studs, etc. Four windows, four by five feet, costing two dollars and one-half each. One door, three by seven feet, costing two dollars. It was built in two days' time by two men, at one dollar and seventy-five cents per day wages, or seven dollars for the work, or, say, labor and nails, ten dollars. The total cost is forty-three dollars and ninety-six cents.

DESIGN XXXIV.

A SMALL POULTRY HOUSE.

Mr. L. E. DeGour, Morristown, Pa., furnishes the following description of a small poultry house, according to the design of one built for himself. The accompanying engravings are made from his sketches. The house is ten

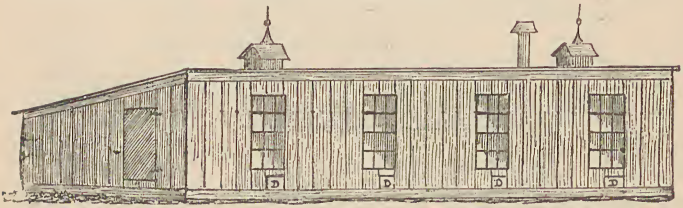


Fig. 164.—EXTERIOR OF A SMALL POULTRY HOUSE.

by thirty feet, seven feet high in front, and five feet at the rear. The boards are "common thirds," with lath placed over the cracks. The roof is tin, with two ventila-

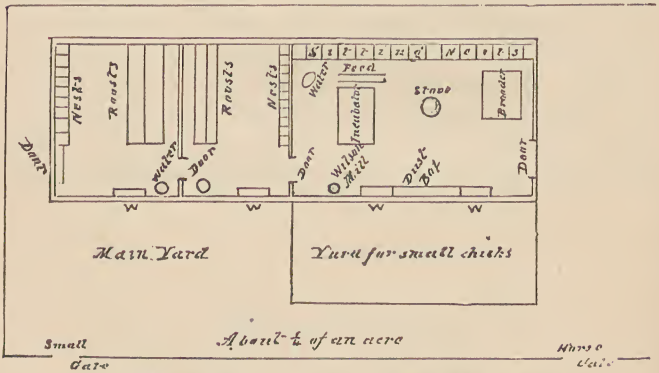


Fig. 165.—GROUND PLAN OF THE POULTRY HOUSE.

tors. The yard for the young chicks has a board floor, to keep them from the damp earth. This house will accommodate seventy-five birds. The materials cost about

fifty-three dollars. Mr. DeGour, though not a carpenter, built the structure, and is sure any one at all accustomed to the use of carpenter tools, can do the same, from the accompanying plan.

DESIGN XXXV.

FOWL HOUSE, WITH HINTS AS TO THE CARE OF FOWLS.

The house here shown is fourteen by twenty-eight feet, eight feet high in the center and five at the sides. The walls are dressed barn-siding, nailed on both sides of braced studs, the space between being filled with dry sawdust, which makes them six inches thick. They rest

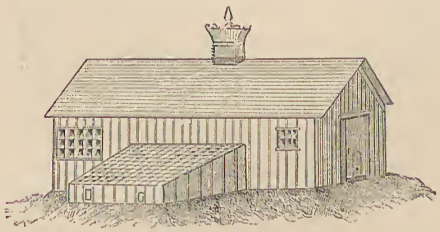


Fig. 166.—A SMALL POULTRY HOUSE.

on a foundation of brick, eight inches wide, which renders them absolutely vermin-proof. The roof is double, filled in with sawdust, same as sides; floor is bare earth, smooth, dry, and hard. A door is in the east end. In the bottom of the door is an opening twelve by eighteen inches square, fitted with a sliding shutter, for the poultry to pass in and out. The two windows rest in grooves, so that they may be slid open, and are covered with coarse wire screens. Extending from the south side of the building, is a glass-covered run, nine by twelve feet,

the floor of which is eighteen inches lower than that of the main building. In its outer end are two openings for ventilation, twelve by eighteen inches square, covered with wire screen, and fitted with sliding shutters. In the main building are the roosts, *r*, *r*, placed two and a half feet above the floor, and fastened to the wall with strong hinges, so that they can be raised when the droppings are scraped out. The nest boxes, *n*, *b*, are fastened to the walls six inches above the floor; the cover over them slopes down, so the fowls cannot use them for roosts. The feed trough is four inches wide, four deep, and eight

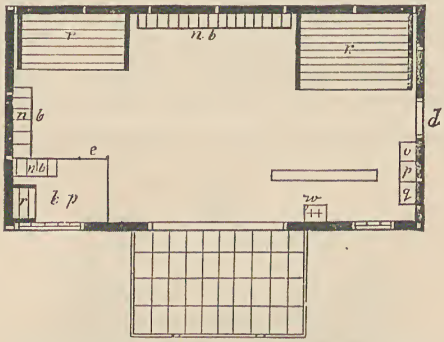


Fig. 167.—GROUND PLAN OF POULTRY HOUSE.

feet long. The water box, *w*, is a tin box or deep pan, set inside a wooden box having a hole three by four inches square in its cover. The sand, gravel, and bone boxes, *o*, *p*, *q*, are near the door. A dust box is in the glass addition. A breeding pen, *b*, *p*, is seven by eight feet square, separated from the main room by a wire screen partition, with entrance, *e*, in one corner. It contains nest boxes, perch, etc. This house, though a comparatively cheap affair, is substantial, and answers the purpose for which it is designed much better than many houses ten times as costly.

A few barrels of dust are placed in the house in summer

for use in winter. The dust box is a foot deep, four feet long, and three wide. It is kept well supplied, and on bright, sunny days the fowls gather in the glass apartment and enjoy the sun and a dust bath. The sand and gravel boxes are kept full of coarse sand and fine gravel. The bone box is always supplied with bones, ground or broken to the size of peas, old plaster or lime, and crushed oyster shells. Nest boxes are cleaned out once in three weeks, sprayed with kerosene, and lined with fresh straw slightly sprinkled with sulphur. Perches are sprayed with kerosene once a month. The droppings beneath them are cleaned out every morning, and the floor of the

Fig. 168.—A SCRAPER.

whole house is scraped once a month with a scraper, here shown, made for the purpose. About once in two months all the fowls are driven out of the building, the ventilators closed, and a large pan full of live coals set inside, upon which is thrown a double handful of sulphur. The door is quickly closed and kept shut for an hour, when the fumes will destroy every living thing in the building. The windows and ventilators are opened and the house well aired before either person or fowl is allowed to enter. Once a year the entire interior of the building receives a coat of fresh lime whitewash to keep it clean and sweet.

DESIGN XXXVI.

DUCKS.—DUCK HOUSES.

Ducks require rather more care than they generally receive. Under good treatment, and where there are sufficient water privileges, they can and do pay better than almost any other kind of poultry bred for market purposes. One of the oldest forms of duck houses, still

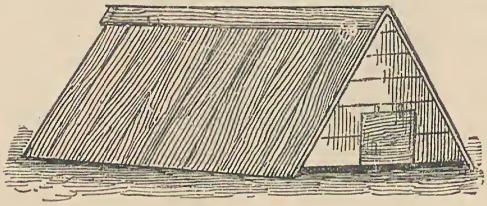


Fig. 169.—OLD FORM OF DUCK HOUSE.

largely used, as it is cheap, easily made, and is neat and comfortable, is here shown. It is merely a night shelter, and is too dark for them to remain in any longer during every twenty-four hours than is absolutely necessary. A very convenient size to comfortably contain twenty or twenty-five ducks, is eight feet long, four feet wide, and

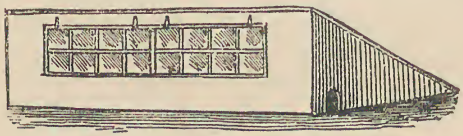


Fig. 170.—AN INEXPENSIVE DUCK HOUSE.

four feet high at the peak. A hinged entrance door is in front, and if desired a large one can be made of part of the house roof. Being merely set upon the ground, it can be moved from one part of the plat to another, with little trouble. For large ones, some have the sills made

like sled runners, and move them with a horse. One inch common pine boards answer well, either tongued and grooved, or battened over the joints to shed rain. The next sketch is of a very good and inexpensive duck house. About half of the south or southeastern front is sash, hung on "loose-butt" hinges, so as to be open or closed, or to be taken off without removing the screws from the hinges. Size, ten to twelve feet long, four to five feet wide; front hight, three feet. The roof having small inclination, needs to be well jointed, and the joints battened, or tarred sheathing paper used, to prevent leakage. If desired, the posts for the front corners can be planted in the ground, which will give firmness, and cost less than framing. Figure 171 shows a more substan

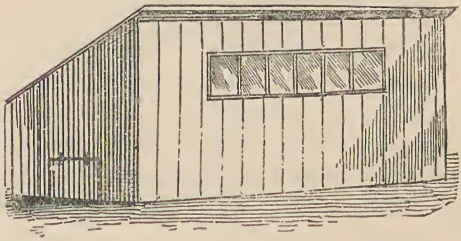


Fig. 171.—A MORE SUBSTANTIAL DUCK HOUSE.

tial and more expensive duck house. Length, eight feet, or longer if desired; four feet wide; hight, five feet in front and two feet in the rear. It has a sash two by five feet in the front, which should face the south. A door for the ducks is made in one end; and a large door for the breeder's use in the opposite or the same end. For the cheapest construction, set corner posts in the ground, thus saving framing. If there should ever be occasion for removing, the posts can be sawed off at the ground surface. The two next designs present a still more expensive duck house, which may have either a round or double pitch roof. Making it seven feet high, gives about

two feet space above the eaves for a pigeon loft, where many a fine bird can be reared. This may be covered with tin, or sheathing; canvas (good second-hand will do) thoroughly painted before and after it is applied, with any good outside paint, will make a substantial, durable, wind and waterproof roof. Sash should occupy

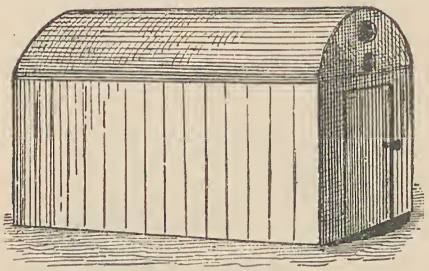


Fig. 172.—DUCK HOUSE WITH ROUND ROOF.

most of the south end, to admit warmth and light. A large door is in the north end; the duck entrance can be placed where most convenient. A ventilator in each end at the peak, is needed for the health and comfort of the ducks. The writer has occasionally learned to his cost, that a hasp and padlock are not unnecessary ornaments.

DESIGN XXXVII.

PIGEONS AND PIGEON HOUSES.

Pigeon houses, neat and attractive, cost but little. The first design shows an independent house, and the one in outline a "lean-to" attached to another building. The former is set on posts about five and one-half feet long, eighteen inches in the ground, and four feet above. These are capped with inverted tin pans to keep out rats, mice, etc. Four to six inches in diameter is heavy enough; cedar or chestnut posts are most durable. The house may be of first-class three-quarter or choice one-

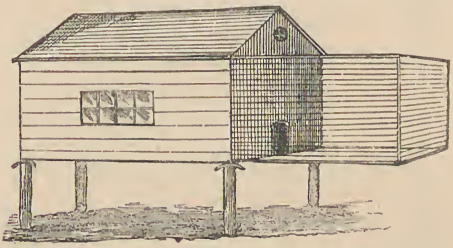


Fig. 173.—AN INDEPENDENT PIGEON HOUSE.

half inch stuff planed on both sides; the floor should be of one inch boards.

Good dimensions are six feet long and four feet wide. Place neat windows in each side, about two feet long and one foot high. An entrance door for the breeder is in the rear (not shown). Make a ventilator in each end under the peak, protecting it from driving rain. The pigeons enter through a skeleton cage affixed on the front end, made as light as possible, but secure, staying it with wires from the two upper corners, and if necessary, placing supports under its outer corners. Common lath will serve for making a neat cage of this kind. It may have a solid floor of one and one-half inch stuff, or be

slatted. The latter is objectionable in many ways. A sliding door, controlled by a string, admits or excludes the birds from this cage at pleasure. Such a house, thoroughly and frequently painted, will last many years, even if made of half inch thick pine boards. Neatness and cleanliness do much to insure success; and purchasers will sooner purchase from and pay the best price to those having the best appearing houses. Pigeons do better and are freer from disease in an out-door house

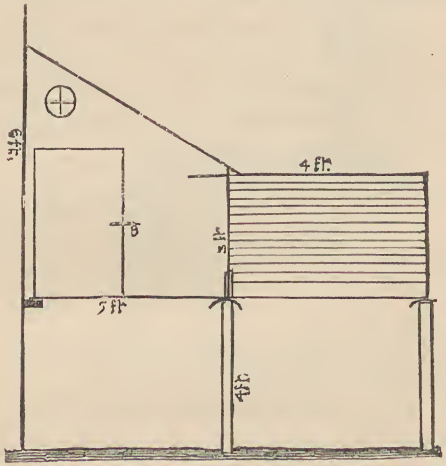


Fig. 174.—A PIGEON HOUSE AGAINST A BARN.

than in one, over-heated and illy-ventilated, in a room in a dwelling house, barn, or granary.

A cheap style of a pigeon house may be built against a barn, granary, or carriage house. If desired, it can extend along the entire end or side of the building. As the building furnishes the back and half the support, it is much cheaper than an independent house. The floor and roof are firmly fastened to the building with strong nails attached to two by three inch pieces. The outer posts are the same as in figure 173, and as many and as long as needed. A good hight is four feet above ground

and six feet from the floor to the highest point, the front being three feet high. Small sash in front, or on either or both of the ends afford necessary light. The floor, ends, and roof should be of inch stuff; for the front, three-quarter or one-half inch boards will do. A skeleton cage or exercise room should run the entire length, supported as shown in the engraving, or the weight may pull the house from the main building. The space underneath may serve as a shelter for small implements, or be fixed to accommodate many chickens at different seasons of the year. Ventilators should be made at each end and at the highest point of this pigeon house.

DESIGN XXXVIII.

OUTSIDE KITCHEN AND SMOKE-HOUSE.

A recently constructed smoke-house, kitchen, and wash-room combined, has given much satisfaction. The dimensions are: Front and back, fourteen feet; sides, twelve feet; first story, nine feet in clear, ten feet from foundation to second floor; second floor to eaves, four feet, and second floor to gable, seven feet. There are folding doors in front, with a combined width of seven feet. The window in the gable is three by five feet, with shutter. The foundation may be of wooden blocks, or brick pillars. The outside measurement of the fire-place is four and a half by two and a half feet; inside, three by two and a half feet, and four and one-half feet high on outside, terminating in a chimney, two and a half by one and a half feet on outside, built on stone foundation to floor, and provided with cranes, and hole for entrance of stove-pipe. The stairway leading to the second story

is three feet wide, entering by means of a trap-door. An opening in the flue in the second story is closed by a sheet-iron or zinc flap; a damper just above the opening deflects smoke into the second story, which is the smoke-house. The meat is suspended foom hooks driven into the rafters. If desired, the window in the second story can be opened while the meat is smoking. The trap-door in the second floor fits tightly, and when it and the window are closed, the smoking-room is dark and tight.

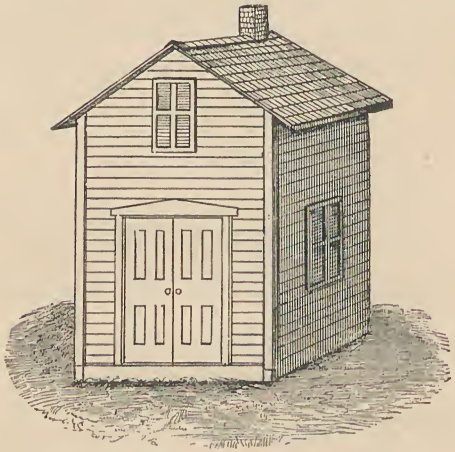


Fig. 175.—EXTERIOR OF SMOKE HOUSE.

The meat can therefore be left on the hooks during the summer. The lower room is used for a kitchen in summer, and for washing, boiling soap, rendering lard, etc. It is connected with the main house by a covered walk. The rooms are not plastered. The lower story is sheathed with inch-sheathing boards and tarred paper, and weather-boarded. The earth is banked up to the sills. Rough sheathing required is eight hundred and fifty square feet; surface weather-boarded, the same; smooth flooring, two hundred feet; rough flooring, the same; tarred paper, five hundred and forty feet; sheathing for roof, two

hundred and forty feet; shingles, two thousand five hundred; for sills, four fourteen-foot pieces; for plates, same; for corner posts, same; studding, thirty fourteen-foot pieces; joists, sixteen thirteen-foot pieces; rafters, ten eighteen-foot pieces; lumber for doors, one hundred

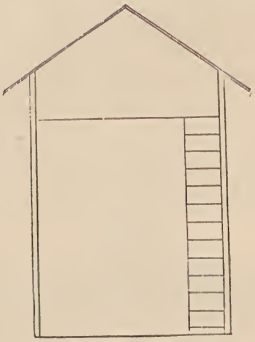


Fig. 176.—CROSS SECTION.

feet; for corner boards, base boards and cornice, two hundred feet. These estimates are all liberal. Our smoke-house is painted with white lead slightly tinged. Cheaper paint and lumber may be used. To make a cheap house on this plan, discard weather-boarding, and board up and down; use rough flooring above and below; make board roof; discard shutters; use mineral paint, etc. But the best, shown in figures 175 and 176, is the cheapest.

DESIGN XXXIX.

WOOD-HOUSE, WASH-ROOM, ETC.

Many families have a very good dwelling-house that answered all purposes when it was first built, but they now want more room in the form of summer kitchen, washing-room or laundry, store-room, etc. The present kitchen may have baking and cooking, washing, ironing, etc., and in many cases this is the only available room, and in the absence of others serves as dining and sitting-room. It is generally desirable to have the wood-house

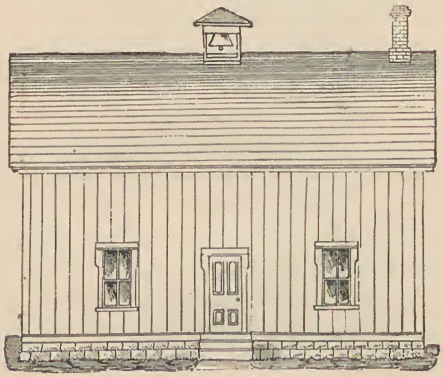


Fig. 177.—SIDE VIEW OF WASH-HOUSE.

and wash-room connected directly with the dwelling, or built as part of it; yet some will prefer to have them separate; while in other instances the addition of these to the present buildings would entail considerable expense, and many undesirable changes, such as shutting out the light from one or more windows, placing the stove in an inconvenient position, increasing the number of doors, etc. The building here presented will supply or suggest one remedy, in the form of a detached building. It is sixteen by twenty-six feet, enclosed either with matched

or battened stuff, planed and painted. The outside entrance is to the wood-room, from which another door enters the wash-room. The wood-room is fourteen by sixteen feet, and is large enough for most houses. A charcoal bin is shown. If hard coal is the principal fuel, the room may be considerably smaller. The coal bin, or bins, if coal is the chief fuel, should have outer doors for filling direct from the wagons. If wood only is used, it should be neatly piled along the end of the room. There should be a door at least three feet wide, at the most accessible place for a wagon, for throwing in the wood. The floor should be supported by strong sleepers or joists,

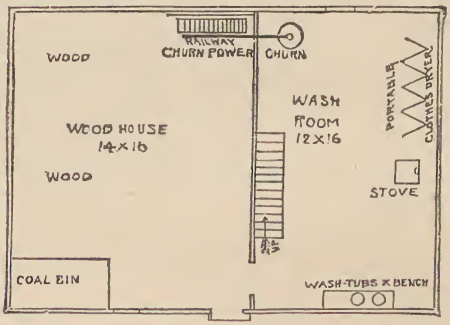


Fig. 178.—INTERIOR OF WASH-HOUSE.

though if the wood is to be worked up under shelter, it is better to dispense with the floor, and simply fill in hard earth a few inches above the outside, to have it always dry. The wash-room is twelve by sixteen, and should contain a stove, stationary wash-bench, tubs, washing-machine, portable clothes-driers; and if a churning power is used, it may be placed in this room, or in the wood-room, and be connected by a band or lever or other gearing, to churn. If the posts of the building are twelve feet, with seven and a half feet walls for the first floor, a commodious room may be placed above, and serve an excellent purpose as a workshop for repairs and making

tools, doing odd jobs, etc. In this case it will, of course, have a work-bench, grindstone, a general assortment of common tools, and a lathe, scroll-saw, etc., will be convenient additions. The stairs can run up from any convenient place, say in front of and four feet from the entrance door, for more readily carrying up long sticks, boards, or other timber, as needed. An upper window is useful for taking in long timber. A portion of this chamber may be used as a place for drying clothes during inclement weather, and for a general store-room or catch-all. It may have a bed-room or two for extra help. And last, though not least, place a bell upon the building, protected from the elements by a small roof. There are steel triangles, now obtained quite cheaply, which answer for bells. So arrange the sink that the water may be poured from the tubs, etc., directly into the drain. The wash-room may be used for paring apples, pitting and drying fruit, trying lard, making soap, and many other important things.

DESIGN XL.

THE FARM WORKSHOP.

The farm workshop should be conveniently located as to both house and barns. Some of the operations to be performed therein will require the use of a fire, more particularly so in the winter, and therefore place the shop so that the strongest prevailing winds will carry all sparks away from other buildings. The size, character, and style of the building will vary with the means and taste of each builder. In length, it should give ample room for a board sixteen feet long, and wide enough to

accommodate a good work-bench, leaving room to run a wagon in alongside, with plenty of space on each side to work at any part to good advantage. The hight should be at least eight feet to the eaves, and the roof may be

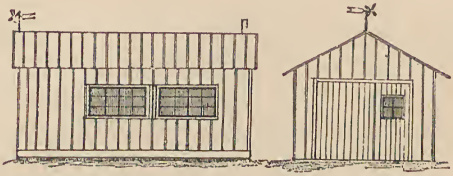


Fig. 179. Fig. 180.

either flat, span, or lean-to, as the builder desires, only it must be water-proof.

The elevations and plan, figures 179, 180, and 181, show a building twelve by twenty feet on the ground, and eight feet high, which will give plenty of room for all ordinary work. To build this, will require about eight hundred feet of one-inch lumber, eight feet long, for sides and roof; two pieces two by six, twenty feet long; two pieces two

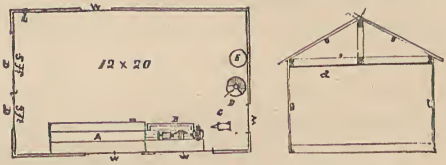


Fig. 181. Fig. 182.

by six, twelve feet long; eight pieces two by four, twenty feet long; four pieces two by four, twelve feet long, and eighty feet flooring for doors. The windows as shown in figures 179 and 180, are of eight by ten glass. Figure 182 shows how the sills and plates are placed. The siding, eight feet long, running up and down, is nailed firmly to the plates and sills. The gables are covered with lumber, lapping down over the ends six inches. The roof boards, eight feet long, run up and down, and are nailed securely to the plates, the ridge, and pieces between.

The roof should be covered with a sheathing of tarred-paper and shingled, or, what is preferable, with a roofing of asbestos, which, if laid according to directions, will give a firm, lasting, and fire-proof roof. The sides may be simply battened, or, what is far better, covered with a water-proof sheathing, battened and well painted. The extra cost of the sheathing will be repaid many times in comfort in cold, wet weather. The doors are made of flooring, having battens firmly fastened on with wrought nails, and hung with heavy strap-hinges. The large door should be hung to swing outwards, and can be fastened by bolting a piece of two by four scantling on the front edge. The small door can swing inward and be provided with a strong lock and a latch.

There should be four or five boards nailed firmly to the under side of the plates and center-piece, as shown at *a*, in figure 182. These may be of any width, the wider the better. Place a board through the center, and another midway each side of this; they will prevent the sides from being pushed apart by weight on the roof. Nail three or four boards from the center-piece to the ridge pole. The space under the roof can be utilized for storing old pieces of lumber, etc., where it will season thoroughly, and be convenient when wanted.

Figure 181 shows the location of the work-bench *a*, foot-lathe *b*, anvil *c*, forge *d*, and the coal barrel *e*.

DESIGN XLI.

ABOVE-GROUND CELLAR OF BRICK.

Above-ground cellars are drier, cleaner, and more healthful and convenient than those situated under

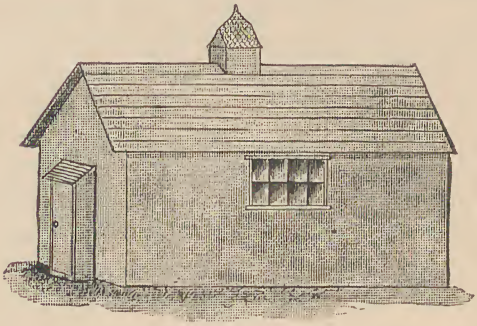


Fig. 183.—A BRICK ABOVE-GROUND CELLAR.

buildings. The accompanying plan is for one made of brick. Stone is equally good, and may be used when cheaper than brick. Figure 183 shows the cellar, exterior;

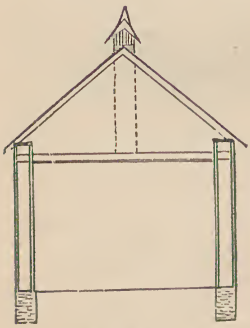


Fig. 184.

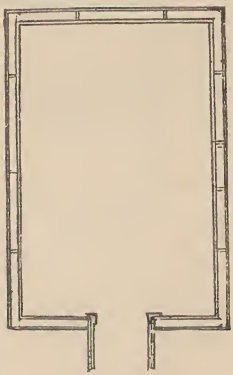


Fig. 185.

figure 184 is a cross-section, and in figure 185 is seen the ground plan. The two walls are twelve inches apart, the

space between being filled with dry saw-dust. Cross-courses tie the walls together, as shown in figure 185. The ceiling is inch-boards joined by tongue and groove, and nailed to the under edge of the tie beams. Two feet of dry sawdust is placed on the ceiling. The roof is sheathed close, and shingled, the ventilator being arranged to open and close. The window is double, with a sliding shutter inside. In cold sections, the entry may be lined with two-inch lumber. Both doors should be closely fitted. The floor may be grouted, or made of brick laid in mortar. This cellar can be of any desired dimensions; the one shown in the engraving is fourteen by twenty-two feet, and seven feet high inside. It may be covered with climbing plants, and should be shaded by trees.

DESIGN XLII.

AN ABOVE-GROUND CELLAR OF WOOD.

Cellars above ground made of wood answer their purposes fully as well as those made of brick. In the one here described, nothing has ever frozen, and once when the thermometer marked thirty-nine below zero outside, the one inside indicated thirty-four above, and a lighted lamp raised it to forty degrees in an hour. Its floor is on a level with that of the kitchen, with which it is connected by an enclosed passage, twelve feet long, lighted with a small window on one side and a large pane of glass in the door on the opposite side. The foundation is two walls a single brick thick, extending eighteen inches into the ground, with a space between of one foot filled with well packed clay. On these walls sills made of two planks eighteen inches

wide spiked together, are laid in cement, making them rat and mouse proof. The above-ground walls, eighteen inches thick, are formed with studding of planks two inches thick and sixteen inches wide, covered on the inside with planed inch-thick boards, and the same on the outside battened. The outer boards, standing upright, will need one or more horizontal pieces for nailing them to, or they would be spread by the packing material, if only nailed to the sills and plates. The space is filled with

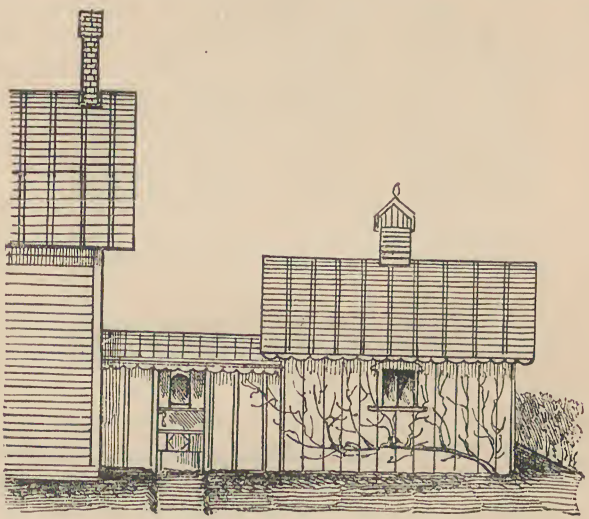


Fig. 186.—EXTERIOR OF AN ABOVE-GROUND CELLAR.

dry sawdust, which needs to be well stowed or it will settle and leave a blank space at the top. The ceiling is of inch boards nailed to two by six inch tie-beams or joists, covered with full two feet thickness of dry sawdust. The roof is of boards, sheathed tightly and covered with rubber roofing held down with battens. Any material desired can be used for the roof; shingles, or, better still, tin or galvanized iron, is preferable to rubber

or tarred paper, unless well protected with a gravel or asbestos covering, as a low roof is subject to fire from sparks. The building is lighted by one double sash window, fitted with a sliding shutter inside. It has only one door, which opens into the passage. In the ground-plan, figure 187: *a* is the door; *b*, window; *c*, passage. A ventilator in the center of the roof can be opened or closed from the inside. Two grape-vines trained to cover the east and west sides, aid in keeping the walls cool in summer. A well grown and closely trimmed barberry hedge, twelve feet from the building, on the north and west sides, is a valuable feature, as it causes the snow to bank high

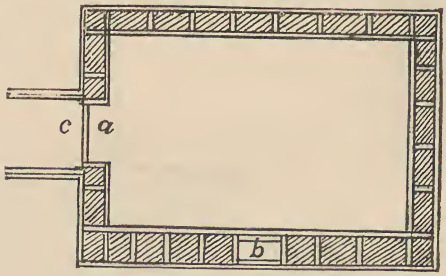


Fig. 187.—GROUND PLAN OF CELLAR.

against the building and act as a blanket during the severe weather which usually follows a snow-storm. The cellar is easily kept clean and wholesome and might be used as a dairy, winter and summer. Such a house, to be used for a dairy room and cellar both, would need to have an apartment with a perfectly tight division wall, as butter and milk are very susceptible to odors from roots and vegetables. For a large vegetable and root or fruit cellar, an outside double door opening directly into the cellar, will save much labor in carrying these articles around through the passage-way. The window might be constructed sufficiently large to admit of passing them through.

DESIGN XLIII.

A LOG ROOT-HOUSE.

The essential points in a good house for the storing of roots are : protection from the frost ; dryness ; and proper ventilation. For those who live in a wooded locality, a house built of logs is cheap and very satisfactory. Such

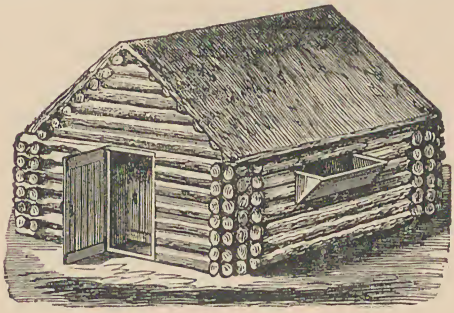


Fig. 188.—A LOG ROOT HOUSE.

a root-house is shown in the engraving. An excavation about three feet deep is first made, and the log walls built around it. The walls should be double, at least a foot apart ; between them earth is placed. The roof is made of timbers, with earth above, thick enough to keep out the frost.

DESIGN XLIV.

INODOROUS CLOSETS.

It is strange that the convenient and less offensive earth closet is not more commonly used on farms and other rural places. The constant threatening of danger from the usual vault or cess-pool, is, or ought to be, so alarm-

ing, that every house should be provided with the inoffensive, and entirely safe contrivance, known as the earth closet. It does not follow that dry earth need be used. Sifted coal ashes, sawdust, dried muck, road dust, may all be used as well as dry earth. An old "out-

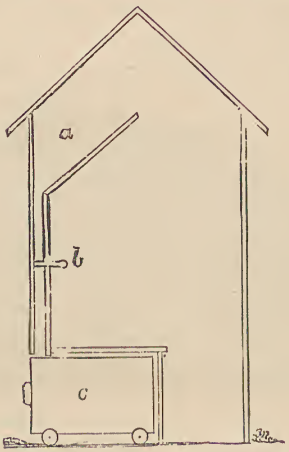


Fig. 189.—A CONVENIENT CLOSET.

building" may be converted by the following plan into a convenient closet. The bin, *a*, at the top, is kept supplied with sawdust or other dry material, peat or earth, which is let down by drawing out the slide *b*. The receiving box, *c*, is on wheels, and can be drawn away to be emptied upon the compost heap, or drawn directly to the garden or field.

DESIGN XLV.

HOW TO DISPOSE OF HOUSE "SLOPS."

Country houses are rarely supplied with such conveniences for removing the house "slops" as are desirable, not to say, absolutely essential, from a sanitary point of view. The sink drain from the house pump, if there is one, gets foul and clogged, sometimes several times in a year, and has to be dug up and cleaned out. An open

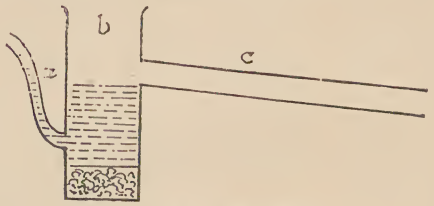


Fig. 190.—A SLOP TRAP.

gutter is filthy, smells badly, taints the butter, breeds flies, and makes folks ill. Slops thrown around the door, are, if possible, as much worse than the drain, as the space slopped over is larger, and closer to the house. The remedy is a covered drain of some kind, to carry the

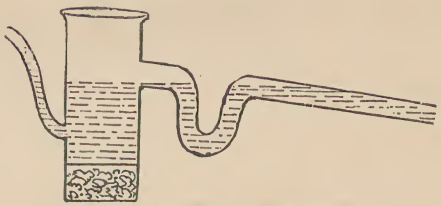


Fig. 191.—SLOP-TRAP WITH U-TUBE.

slops to a distance, where they may be economized. They ought never to be thrown into the pump-sink, but into an open receptacle, from which the drain flows. A very good way, which has commended itself to the

writer, is to have a receiver, not less than a foot square, laid up of brick, in cement, altogether about four feet deep, as in figure 190. Out of this, from about the middle, the drain, *c*, flows, also laid in brick (though one of oak boards will last a long time), and into which, a little below the middle, the water pipe, *a*, from the pump-sink, enters. The foul water thrown in at *b*, will deposit its sediment, and flow off tolerably clear by the drain *c*, while the mouth of the sink-pipe, being below the surface of the water, admits of no foul air passing back to the house. It is easy to clear out the sediment in the receiver with a post-hole spoon, and to flush the drain by pouring a tub-full of water at a time into the receiver. The top of the receiver should be protected by a grating or a lid. To prevent foul air drawing up the drain, as it will often do, a U-trap of tile may be placed near the receiver, as shown in figure 191. The trap should be underground, the top being level with, or raised a little above the surface of the ground.

USEFUL MEMORANDA FOR ESTIMATING.

Excavations.—To find the cost of excavating, get it into cubic yards. The price per cubic yard varies from ten cents to thirty cents per yard. If a scraper can be used to deposit the dirt near the site of the building, estimate the cost at ten cents per yard. If it is necessary to pick and scrape the ground, estimate twenty cents per cubic yard. If very hard, and blasting becomes necessary, the cost will be from forty cents per cubic yard, and upwards.

Footings.—These may be of stone or concrete. If of stone, take the superficial feet, and state the thickness of footings; this is done, because the footings usually come from a different quarry. If out of the same quarry as that used in the walls, they may go in with the rest of the stone on cubic measure. If they are of concrete, reduce it to cubic feet. If the concrete is composed of ordinary water lime and medium-sized stone, estimate ten cents per cubic foot. If made of cement and finely broken stone, estimate it at twenty or twenty-five cents per cubic foot. The cost of stone footings will of course vary according to the locality; two dollars and a half per perch is considered an average price. The number of cubic feet in a perch also varies. In the New England States, a perch is computed at sixteen and one-half cubic feet. In Pennsylvania, twenty-two cubic feet are called a perch. In many localities, the standard of twenty-four and three-fourths cubic feet is used.

The weight of different soils varies as follows:

22 cubic feet of sand will weigh 1 ton.
21 cubic feet of earth will weigh 1 ton.
19 cubic feet of gravel will weigh 1 ton.
18 cubic feet of clay will weigh 1 ton.

A cubic yard of earth is usually estimated as one load; two cubic yards make a double load. A cubic yard of earth increases from one-fourth to one-half of its original bulk, when dug.

STONE WALLS.—For foundation walls below the water table, measure the walls and get them in cubic feet; reduce the cubic feet to perches, and multiply this result by the price per perch, which will vary according to locality.

ABOVE FOUNDATIONS.—"Ashler" in a wall is separately measured in superficial feet and stated average thickness; multiply this by the cost per square foot. The cost varies from fifty cents to three dollars per square foot, according to location, hight, etc. In estimating "ashler" work, the openings should be deducted.

BRICK WALLS.—There are two ways of estimating the cost of brickwork. We can find the contents of the walls in cubic feet, multiply this by the number of bricks in a cubic foot, which is twenty-one, and we get the work in terms of thousands of bricks. Multiply the number of thousands by the price per thousand, and we get the cost of the entire work. Or we may use another method: Get the superficial area of the walls, and multiply this by the number of bricks in a square foot of surface for the wall of the given thickness.

A superficial foot of gauged arches requires ten bricks.
A square foot of 4-inch wall requires 7 bricks.
A square foot of 8-inch wall requires 14 bricks.
A square foot of 12-inch wall requires 21 bricks.
A square foot of 16-inch wall requires 28 bricks.
A square foot of 20-inch wall requires 35 bricks.

The bricks of different makers vary in dimensions, and those of the same make also vary, owing to the different degrees of heat to which they are subjected in burning. The following table—from Kidder's "Architects' Pocket

Book"—gives the dimensions of bricks in different parts of the country:

Baltimore fronts	2⅞ by 4½ by 8½ inches.
Philadelphia fronts	2⅜ by 4⅛ by 8½ inches.
Wilmington fronts	2⅜ by 4⅛ by 8½ inches.
Trenton fronts	2⅜ by 4⅛ by 8½ inches.
Croton fronts	2½ by 4 by 8½ inches.
Calabaugh fronts	2⅜ by 3⅝ by 8½ inches.
Maine fronts	2⅜ by 2⅜ by 7½ inches.
Milwaukee fronts	2⅜ by 4⅛ by 8½ inches.
North River fronts	2¼ by 3⅛ by 8 inches.
Ordinary fronts	2¼ by 3⅝ by 7¾ inches. 2¾ by 4¼ by 8¾ inches

The weight of the smaller bricks is about four pounds, and of the larger, six pounds. Dry bricks, when immersed in water, absorb from one-half to three-fourths of a pound of water each. Openings in brick walls are usually deducted, unless very small. In estimating pressed brick, the jambs of the piers between doors and windows, should be measured back to the wood-work. Measure the arches as solid down to their chord. The cost of laying in red mortar is about twelve cents per square foot. Common bricks, per thousand, laid in the vicinity of New York, cost sixteen dollars at the present time. Pressed and ornamental brick-work, at special prices, varying from thirty dollars per thousand upwards.

"A load of mortar measures a cubic yard, and requires twenty-seven cubic feet of sand and nine bushels of lime, and will fill thirty hods."

One thousand bricks, closely stacked, occupy about fifty-six cubic feet of space. Bricks are usually estimated at five courses to one foot in hight.

CHIMNEYS.—Bricks for chimneys for each foot in hight, as follows:

Size of flue, 8 by 8 inches. Size of chimney, 16 by 16 inches. Number of bricks each foot in hight, 30.

Size of flue, 8 by 12 inches. Size of chimney, 16 by 20 inches. Number of bricks each foot in hight, 35.

Size of flue, 8 by 16 inches. Size of chimney, 16 by 24 inches. Number of bricks each foot in hight, 40.

Size of flue, 12 by 12 inches. Size of chimney, 20 by 20 inches. Number of bricks each foot in hight, 40.

Size of flue, 12 by 16 inches. Size of chimney, 20 by 24 inches. Number of bricks each foot in hight, 45.

There is another way of estimating the number of bricks in a chimney: Find the number of cubic feet in the chimney; allow twenty-one bricks per cubic foot. If the flues are many, and very large, deduct them. Two casks of sand, mixed with one cask of cement, will lay six hundred bricks.

For concrete floors, two casks of gravel mixed with one cask of cement, will cover six square yards two inches thick.

CUT STONE.—This requires a detailed estimate; each piece should be given accompanied by a sketch, or cross-section. Group those of a kind together, and give lists of columns, capitals, and all else that is cut-work. After the list is made out, get it into cubic feet, and any good stone-cutter will give the price per foot. Water-tables are usually estimated by the running foot. The price of cut stone also varies with the locality. Three dollars per cubic foot not laid, and fifty cents for laying and setting, is an average price. Or the whole may be estimated in running feet.

WOOD-WORK.

Wood comes in two forms, and is known as timber, and lumber. In general, any stuff over one inch in thicknesss, and used for rough work, is timber. One-inch stuff, and under, is lumber. Stuff for finishing may be two or three inches thick, and yet called lumber.

All measurements of wood are stated in "board measure," that is, one foot square, and one inch thick. Timber and lumber are sold by the thousand feet. In timber-work, state the number of pieces, the length, the width, and the depth. Thus:

20 pieces, 6 by 10 by 16 feet: 1,600 feet; and so on.

The rule is, to multiply the dimensions (feet and inches, without reduction) together, and this product by the number of pieces, and divide the whole by twelve, the result being in "board feet." The length of boards are twelve, fourteen, sixteen, eighteen and twenty feet; anything over twenty feet must be cut to order. If lumber is one and one-quarter inches thick, you must simply add one-quarter to the measurement of superficial area. If the boards are less than one inch in thickness, no deduction is made, but counted as inch stuff.

WASTE.—Much waste comes from building rooms and portions of frame buildings whose lengths or widths are an even number; thus: a room fourteen foot wide, requires sixteen-foot boards; therefore, have your widths odd numbers. In the rough allow ten per cent for waste, and in fine work a greater per cent. One-fifth more siding and flooring is needed than the square feet of surface to be covered, because of the lap of the side, and matching. For floors, wood ceiling, etc., which are tongued and beaded, one-half inch is allowed for the tongue. If the stuff is two inches wide, figure the area, and then allow twenty-five per cent. for the matching. If four inches wide, add twelve and one-half per cent., etc., etc. The general rule, however, is to allow twenty-five per cent. for matching and waste; thus, if we have one thousand square feet to cover, we would buy twelve hundred and fifty feet of matched stuff. In laying clapboards, you only pay for the amount of lumber used, as clapboards are made by sawing boards one by six inches diagonally. It costs about one dollar and fifty cents per thousand feet for sawing.

OPENINGS.—In wooden houses, if we wish to get at the amount of stuff, we take out half the openings. If we wish to get the cost, the openings are not taken into account, because the extra fitting is equal to the extra

cost of the additional materials, and we take no account of openings unless large and numerous. Again, some carpenters compute floor areas entire, and for the openings allow nothing for waste.

Mouldings.—Architraves, bases, bands, cornices, are all measured in running feet, and, with these figures, give a figured section of each.

Doors.—Here give a detailed bill, stating the number of each kind, and its respective size. Thus:

10 doors, 2 inches thick; 2 feet 6 inches wide, and 6 feet 10 inches high.

3 doors, 1$^1/_2$ inches thick, 2 feet 6 inches wide, and 6 feet 10 inches high.

In cheap work, never make doors 7 feet, etc., because boards will work with less waste 6 feet and 10 inches; or, you may have them 7 feet 4 inches.

State if the doors are square, segmental, or round-headed. State the number of panels, and whether moulded or chamfered, and if on one side, or both. Closet doors (and doors for cheap work) are only moulded on one side. Doors are classified in factories according to the thickness; thus: they are one and one-quarter, one and one-half, one and three-quarters, and two inches thick. If the doors are to be moulded, make a sketch. A good way is, to obtain a catalogue from any good manufacturer, of the thicknesses and sizes kept on hand. The manufactured doors are much better than those made by general carpenters, as the former doors are well seasoned.

Windows.—First: State if they are square or round-headed.

Second: Give the number and dimensions, thus: ten windows, three feet by five feet eight inches inside of jambs. Sashes range in thickness, thus: one inch, one

and one-quarter inches, one and three-quarter inches, and two inches. State the number of lights.

Glass increases by inches up to twenty inches, beyond which it increases by two inches. You can easily obtain a catalogue from any glass manufacturer, in which all sizes are given. There is no such thing in market as first quality French sheet window glass, because this kind is all taken up in the manufacture of mirrors. We have first quality American sheet, as well as second quality. French-window sashes should be two inches thick, otherwise they will warp.

Sash Doors.—Here give the size of lights. The cost of these doors are about the same as the panel doors. They do not differ in price more than fifty cents or one dollar each from the common panel doors.

Stairs.—Give the number of the risers, and give the number and sizes of newel posts. Give the number and sizes of balusters, and also the length of hand-rail with a figured cross section. Mention the materials used as oak, ash, walnut, etc.

Verandas.—Give area of flooring, allowing twenty per cent for waste, and ten per cent for matching. Thus we would order two hundred and sixty square feet, if the veranda floor was ten by twenty feet. State the number and sizes of posts, and the same for braces; the number of feet of railing. In estimating, keep the bill of pine separate from the bill of hemlock. First, go through the house and find the amount of hemlock, after which take up the bill of pine, in the same way. In ordinary houses we can get the bill of quantities from the ordinary plans and elevations; but in important works, the framing plans are necessary.

Plastering.—Plastering is measured in square yards. Make separate bill for each kind of work, thus: so many square yards on lathing, three coats. Or, so many square

yards on lathing, two coats: or, so many square yards plastering on brick-work. Use two coats on brick walls, if they are not to be papered. If to be papered, use only one.

Cornices.—For moulding, etc., give the number of running feet with a figured section of each. One hundred laths will cover about six square yards of surface. One thousand laths will cover sixty yards. One cask of lime to ten bushels of sand will cover about forty-five square yards of plastering, estimating two hundred pounds of lime in a cask, by dry measure, equal to two and one-half bushels. A measure of lime is a single load or cubic yard. A bushel of hair weighs, when dry, about fifteen pounds. Three men and one helper will put on four hundred and fifty yards in a day's work, of two-coat work, and will put on a hard finish for three hundred yards. Nine bushels of lime, and one load or cubic yard of sand, and eighteen pounds of hair, will make a load of mortar, and will fill thirty hods.

ROOFING.

The pitch of a slate roof should be not less than one foot in hight to two feet horizontal. Slates are estimated by the square. A square of slate is one hundred superficial feet, allowance being made for the trouble of cutting the slate at the hips, eaves, and around chimneys, etc. To compute the number of slates in a roof, subtract the head cover, which is usually three inches, from the length of the slate. Multiply the remainder by the width and divide by two. This will give the number of square inches covered by a single slate; dividing the number of square inches in a square by the number of inches in a single slate, will give the number

of slate in a square. Allowing three inches for head cover, the number of different sized slate in a square, are:

533	Slates,	6x12	inches,	to	cover	one	square.
457	"	7x12	"	"	"	"	
400	"	8x12	"	"	"	"	
355	"	9x12	"	"	"	"	
374	"	7x14	"	"	"	"	
327	"	8x14	"	"	"	"	
291	"	9x14	"	"	"	"	
261	"	10x14	"	"	"	"	

The nail holes should be near the top, and each slate should be fastened by two three-penny galvanized iron, copper, or zinc nails. The roof-boards should be covered with tarred felt roofing paper, before the slate are laid. Ordinary roofing paper weighs about fifteen pounds per square, and averages about fifty pounds in a roll.

SHINGLES.—The average width of a shingle is four inches. Good eighteen inch shingle will lay one hundred and thirty feet per thousand, laid five and three-fourths inches to the weather. Sixteen inch shingles, five inches to the weather, will cover one hundred and fifteen square feet; fifteen-inch shingles laid three and three-fourth inches to the weather, will cover one hundred square feet. The following table will be found convenient for common gable roofs.

900	Shingles,	4	inches	to	the	weather,	will	cover a square.
800	"	4½	"	"	"	"	"	"
720	"	5	"	"	"	"	"	"
655	"	5½	"	"	"	"	"	"
600	"	6	"	"	"	"	"	"

For hip and valleys add five per cent to the above. A good workman will carry up and lay on the roof from fifteen hundred to two thousand shingles per day, of plain work.

NAILS.

For 1000 shingles allow 3½ lbs. 3d nails to fasten them on.
For 1000 shingles allow 5 lbs. 4d nails, to fasten them on.
For 1000 lath allow 6 lbs. 3d fine nails, to fasten them on.
For 1000 feet clap-boards allow 18 lbs. 6d box nails, to fasten them on.

For 1000 feet boarding allow 20 lbs. 8d common nails, to fasten them on.
For 1000 feet boarding allow twenty-five lbs. 10d common nails, to fasten them on.
For 1000 feet top floor square edge allow 38 lbs. 10d flooring nails, to fasten them on.
For 1000 feet top floor square edge allow 41 lbs. 12d flooring nails, to fasten them on.
For 1000 feet matched blind-nailed allow 35 lbs. 10d flooring nails, to fasten them on.
For 1000 feet matched blind-nailed allow 42 lbs. 12d flooring nails, to fasten them on.
For 10 partition studs allow 1 lb. 10d common nails, to fasten them on.
For 1000 feet furring, 1x3 inches, allow 45 lbs. 10d common nails.
For 1000 feet furring, 1x2 inches, allow 65 lbs. 10d common nails.
For 1000 feet pine finish, allow 30 lbs. 8d finishing nails.

20d	nails,	2⅜	inch	long,	36	nails to the	pound.
30d	"	4	"	"	24	" "	"
40d	"	4½	"	"	18	" "	"
50d	"	5⅓	"	"	13	" "	"
60d	"	6	"	"	9	" "	"
70d	"	7	"	"	6	" "	"

APPROXIMATE ESTIMATING.

Common Houses.—A common way is to find the cubic contents, and multiply this by a price gained from the actual cost of other houses, of similar style and finish. This method of estimating gives the price within five per cent. of the cost. To get the cubic contents, multiply the surface area by the hight. The hight is taken from the bottom of footings to the top of the roof, if the roof is flat. If the roof is gabled, take one-half way up the gable. This method does not usually include the price for heating or plumbing.

PAINTING.

No general rule can be given for estimating the cost of painting, as much depends upon the quality of the materials and the skill of the workman in mixing it and putting it on. It is customary to charge for each coat of paint

put on, and every part that is painted should be measured, and allowance made for covering deep quirks in mouldings, carved surfaces, difficult mouldings, railings, etc.

The priming coat (according to Kidder) will take four gallons of oil and twenty pounds of white lead, to cover one hundred yards. The second coat will require about four gallons of oil and forty pounds of lead; third coat, the same as second. Or, one hundred square yards surface painted three coats, will require twelve gallons of oil and one hundred pounds of lead. A square yard of new brickwork requires for the first coat three-fourths of a pound of paint in oil, for the second coat three pounds, and for the third, four pounds. A day's work on the outside of a building is one hundred yards of first coat, eighty yards of second, and each succeeding coat. In painting blinds of ordinary size, twelve is a fair day's work for one coat, and will require one gallon of oil and nine pounds of lead to paint them.

Fifty yards of common graining, with one man to rub in, is considered a day's work for a grainer.

LIMES, CEMENTS, AND MORTARS.

Lime.—Pure lime can be obtained by burning statuary marble; commercial lime by burning some kind of lime stone. The impurities of lime are (1) silica, (2) alumina, (3) iron, and (4) magnesia. These are always present. If the lime is pure, it is called "fat lime," though still having ten per cent. impurities. It is called also, "common lime." If the impurities amount to from fifteen to forty per cent., and consist chiefly of alumina and magnesia, it is called "hydraulic lime;" if from forty to sixty, it is called "hydraulic cement."

Hydraulic lime and hydraulic cement will harden under water. Fat lime is best when fresh from the kiln. Hy-

draulic lime and cement must be ground up so as to be mixed with water, and when set, is sometimes stronger than fat lime.

ARTIFICIAL CEMENT.—Puzzolana and Trass are clays containing lime, potash, and magnesia. If the Puzzolana and Trass be mixed with fat lime, there is formed a very strong cement.

PORTLAND CEMENT is a double silicate of lime and aluminum, with some oxide of iron and magnesia, which are of no service in the cement. Dark-colored cement is very good. Cement which is mixed up and does not set for five or ten minutes, is generally most durable. If it is quick to set, it is not so durable. The heaviest is always the best; about one hundred and ten pounds to the bushel is good weight.

PLASTER OF PARIS is obtained by "burning" (heating) gypsum, to drive off the water. It is then ground up. When mixed with water, it hardens again, and is used in the filling of safes, and about fire places, for forming mouldings, and similar work.

FINISHING CEMENTS are mostly manufactured in England. They are used to get fine, smooth surfaces on the walls of rooms.

"KEEN'S" CEMENT is made by soaking plaster of Paris in a solution of alum. The water is vaporized, after which it becomes hard, and is ground up into powder; when wet up again, it sets very rapidly, and becomes very hard.

"PARIAN" CEMENT is made by mixing gypsum with borax; then calcine, after which it is ground up.

"MARTIN'S" CEMENT is made by mixing water glass with a paste of fat lime. A chemical change thus takes place, which produces silicate of lime. This is a very durable cement.

MORTARS.

Lime Mortar is a mixture of water-slacked lime, sand, and water. There are two kinds of slacking. First, air-slacking, done by leaving the lime to absorb moisture from the air. Second, slacking in the ordinary way, by mixing water with the lime; the water should be mixed slowly, by sprinkling. Pure fat lime will take up two and one-half times its weight of water; common lime, about twice. It also increases in size about two and one-half times its bulk, and becomes very hot.

Lime Paste is lime mixed with more water than it will take. It is used for making mortar. In making mortar, make the lime paste first; then let it stand awhile before mixing in sand, otherwise there will be particles of unslacked lime which, when in the walls, slack and break, or blister the wall. After four or five days, the sand is added, the portion depending upon the kind of work to be done. About one part of sand is the minimum, and four parts the maximum. The sand prevents the lime from cracking or stretching. The purer and sharper the sand, the better will be the mortar. Almost any kind will harden under brick or stone, from the pressure. The mortar in a newly-plastered house may be hardened quickly by burning charcoal in the open room, but great care must be taken not to become asphyxiated by the fumes, which are almost imperceptible, but very fatal. Mortar is never hard or dry, until after three or four months. In the first two or three weeks, it should be made to dry very slowly. Lime mortar should be mixed, and left a month before being used—the more mixed the better. Sometimes the mortar is frozen; then when it thaws, the mortar is spoiled. In Canada, and places where the weather is constant, they let it freeze on purpose, the water passing without thawing from the chrystalized

form to a vapor. When we use mortar for first coat on a wall, it should be mixed with hair; this hair gives it a cohesive power; the hair being mixed in before the sand.

The finishing coats are of three kinds:

1) Rough finish, when the wall is to be papered, which consists of simply smoothing it over.

2) Hard finish, which is made of lime paste, plaster Paris, or marble dust.

3) Sand finish, made of lime paste and sand. The more lime swells the better it is said to be.

Hydraulic Lime.—This takes less water to slack; it produces less heat, and does not slack or swell. If it does not take water or produce heat, it is cement. Hydraulic lime must be mixed up when used. In making the lime, not so much sand is required; about one or two parts of sand. It does not shrink any; hence no sand is absolutely needed. We put the sand in for economy, as it does not injure the mortar. Cements that set slow, are best.

Test of Cement.—1) Take a spoonful and mix it with water, and if it hardens quickly, it is good; but not the best. If it hardens in a day, it is much better. 2) Take some cement and mix it with muriatic acid, and if a white gelatinous substance is formed, the cement is good, for this shows the presence of silica in condition to form silicate of lime, which is the foundation of all cements and mortars.

Selenitic Mortar is a mixture of lime and plaster of Paris. This is very strong, and we can put it with six parts of sand. This, however, will not replace cement. The ancient Romans made their mortar of lime sand and powdered bricks mixed together in equal parts; they slacked their lime very slowly, then kept it in this paste for a very long time, after which they mixed it with the sand. If mortar becomes poor, and one-tenth or one-

eighth part of good cement be added, the mortar will be good again.

Common Lime Mortar for Brick.—The mortar used for pointing outside work is made of pure lime paste and sand. Cement may be added to make it harder. For coloring of cements, the oxides of metals are used. Bone black generally fades. There is a good German black cement, costing about eight dollars per bushel.

Oleaginous Mortars — Mastic Mortar (Mortars mixed with oil).—These are used to cover rough stone or brick walls. It makes a smooth surface, and when colored and lined off, it appears like brown stone.

A good mastic mortar is thus prepared :—A dry mixture of sand, powdered limestone, and litharge is made ; then linseed oil is added and well mixed through. Instead of powdered limestone, slacked lime may be used, but is not so good.

Another kind consists of white and red lead mixed with cement and with linseed oil, and also some animal oil.

Still another is prepared thus : Pure fat lime is slacked in oil, and then mixed with cement.

The wall to which any mastic mortar is applied, must be perfectly dry. If it is injured, it is almost impossible to repair it, without leaving a bad effect, as it is most difficult to match the color.

Stuccoes (Hydraulic lime mortar) — One kind is adapted to very rough walls. It is a mixture of cement-slacked lime, sand, or gravel. Sometimes hair is mixed ; also gravel. Preparation : Two parts of sawdust and five parts of sand, mixed dry ; three and one-half parts of lime and one part of cement, mixed while dry, and thoroughly worked. It must be used before danger from frost.

Stuccoes of a finer kind, used for interior work, may be made by taking pure fat lime, slacked perfectly for five

months, and beaten up well every two or three weeks, then mixing it with powdered limestone, chalk, or plaster Paris. This makes a very hard surface, which may be colored, painted, or polished. Those colors which are metallic oxides, must be applied to the stucco while moist : such colors, as umber (blackish brown), smalt (deep-blue glass), ochre (a variety of clay-green, blue-black, and yellow).

Scagliola (a kind of stucco made to resemble marble) is made with pure gypsum with variegated colors, to represent marble. In St. Peter's church, at Rome, this is much used.

Concrete (used as foundation of walls in springy soils). —It is an artificial stone, made of lime or cement, mixed with small stones, gravel, sand, and water. There are two kinds : lime concrete, and cement concrete.

Lime Concrete.—There are three common ways of making it. The first is, when common lime mortar is mixed with small stones or gravel, the proportions being two parts of stones and gravel to one of mortar ; broken bricks are very good. This mixture is laid upon a bed between two planks, and when hard, the planks are removed. This is sometimes called "mud wall." The outside of this mud wall should be stuccoed, and then it makes a very cheap wall. Another way is to fill the horizontal wall with stones, and afterwards pour in the "grout" (coarse-running mortar).

Cement Concrete ("Béton" concrete) is made of hydraulic lime and sand, mixed while dry ; water is added, and the mortar is then mixed with stones or broken bricks; The stones should be egg-size and sharp. It is an artificial stone and gravel in a mixture of cement, used for submarine works. There should be no clay in the gravel. The proportions may be as follows : 1) one part of hydraulic lime to two parts of stone and gravel ; 2) one part of cement to two of sand, two of gravel, and two of stone ;

3) one part of cement to three of sand and three of stone. "Béton conglomerate," or "cocquet," is prepared by mixing one part of lime, one-half part Portland cement, and five parts of sand. All mixtures of hydraulic lime and cements must be immediately used, as it quickly sets. Cement and lime concrete are used for cellar and bottoms and cisterns.

Cement pipes are not good for conveying water, on account of the pressure, but are good for drain pipes. Glazed pipes are, however, supplanting them for this purpose. If an iron water-pipe runs through a stone wall, or is otherwise exposed, and there be danger of its freezing, coat it with cement, which is a frost-proof material.

Ransom is an artificial sandstone, made by mixing sand with powdered limestone, and after this, adding one gallon of silicate of soda to one bushel of the mixture, which is then to be put in a mould and wet with chloride of calcium. All concretes should be mixed in small quantities, and used fresh. Mix dry upon a plank bed, before adding water.

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